

Potential for Legume Inoculation in Vietnam

Pham Van Toan¹

Abstract

Legume crops have a long history of cultivation in Vietnam and play an important role in Vietnam agricultural systems. In recent years, the nation's legume crop scientists have expended considerable effort to access and learn from advanced cultivation technologies available in the world, and to develop and to disseminate to Vietnam's farmers yield-enhancing new varieties and sustainable technologies. The average groundnut yield increased from 13 quintals/ha in 1995 to 15 quintals/ha in 2000 and from 7.9 quintals/ha in 1995 to 10.4 quintals/ha in 2000 for soybean. However, legume yields in Vietnam remain low compared to those of other Asian countries, where soil and climatic conditions are similar. Research, development and dissemination of advanced cultivation technology to achieve high legume yields and decreased production cost are the wish of all Vietnamese agricultural scientists and farmers. Legume inoculation is one of the ways to meet these challenges. This paper discusses the status of legume inoculation research and development in Vietnam as well as the potential for legume production in Vietnam.

Status of Legume Inoculation Research and Development in Vietnam

VIETNAM is predominantly an agricultural country with more than 7 million ha of agricultural land, so the demand for the fertiliser is very high. For the past 15 years, the mineral fertiliser supply has been continuously increasing by 7% of nitrogen (N) fertiliser, 8% of phosphorus (P) fertiliser and 12% of potassium (K) fertiliser (Table 1). This tendency will continue in the coming time. At present, the chemical factories can produce only 20% of N and 80% of P fertiliser demand. The government has to balance this by importation, which every year costs nearly US\$500,000 (Table 2). To improve this situation, Vietnam has planned to expand existing factory capacity, while stimulating research, production and the utilisation of biofertilisers. The research on rhizobium symbiosis has been carried out in Vietnam for more than 20 years. There are 5 scientific organisations working on it (Table 3) with more than 50 scientists. They are capable of carrying out different research on rhizobium inoculant development, with main activities as follows:

- Collection, isolation and preservation of Rhizobium strains;

- Testing N-fixing activity of isolated Rhizobien by ARA or ¹⁵N method;
- Developing Rhizobium inoculant for groundnut and soybean in different combination (single R.strain, multi R.strains or mix of Rhizobium and other N- fixing or P-solubilising microorganisms...);
- Field trials and demonstrations on the effect of Rhizobium inoculant on the legume growth and yield in different legume cultivation zones (mountain and midland, Red River delta, Middle Vietnam, Southeast Vietnam and Cuulong delta).

Rhizobium inoculant can increase pod yield of groundnut 13.8–17.5% in North and Middle and 22% in South Vietnam (Table 4, 5 and 6). In combination with an N fertiliser dose of 30–40 kg/ha Rhizobium inoculant has the same yield as an N-fertiliser dose of 60–90 kg/ha. The effect of Rhizobium inoculant is especially high in poor soil and new land under legume cultivation. The benefit of Rhizobium inoculant can be estimated at about 400,000–500,000 VND/ha. Rhizobium inoculant is very useful and benefits farmers. Because of limited funds and lack of technical equipment, it could be produced only at laboratory scale during the time of the project. At present, Vietnam has no company producing Rhizobium inoculant, so that the demand for the Rhizobium inoculant cannot be met here.

¹ Vietnam Agricultural Science Institute, Thanh Tri District, Hanoi, Vietnam

Table 1. Fertiliser utilisation in Vietnam (1000 t).

Kind of fertiliser	Year				
	1981	1985	1990	1995	2000
Nitrogen	175.7	267.0	358.8	506.0	690.0
Phosphorus	38.4	49.0	82.6	185.0	260.0
Potassium	22.0	22.1	27.8	31.6	166.0

Source: Bui Huy Hien (pers. comm.)

Table 2. Fertiliser importation in Vietnam.

1997		1998		1999	
Quantity (1000 t)	Cost in 1000\$US	Quantity (1000 t)	Cost in 1000\$US	Quantity (1000 t)	Cost in 1000 \$US
2,458.373	424,946	3,454.213	474.697	2720	400.00

Source: Tu Kien 2000

Table 3. Research organisations working on legume inoculation in Vietnam.

Name of research organisation	Main activities
1. Vietnam Agricultural Science Institute (VASI)	Coordination of Rhizobium inoculant projects from 1982–1989 National centre for agricultural microorganisms Collection and preservation R&D of production technology of N-fixing and P-solubilising inoculants transfer technology to production companies
2. Agricultural University Hanoi	Rhizobium inoculant development for soy bean and carrying out the field trials
3. Research Institute of forestry	Rhizobium inoculant for forestry trees
4. Institute of R&D of biotechnology, CT University	R&D of Rh.inoculant for soy bean
5. Oil plant research institute	Field trials of Rhizobium inoculants for legumes
6. Agricultural Institute of South Vietnam	Rhizobium inoculant for groundnut and soybean

Table 4. Effect of Rhizobium inoculant on grain yield of groundnut in North and Middle Vietnam.

Soil	Fertiliser	Grain yield (t/ha)		Increasing to control	
		Control	Inoculation	t/ha	%
Infertile soil	NPK 30:60:60, FYM 5 tonnes	19.72	22.72	3.0	115.2
Fertile soil	NPK 30:60:60, FYM 5 tonnes	23.1	26.31	3.21	113.8
Feralit soil	NPK 30:60:60, FYM 5 tonnes	15.76	18.53	3.76	117.5

Source: Ngo The Dan et al. 2000

Table 5. Effect of Rhizobium inoculant on grain yield of groundnut in South Vietnam.

Cropping system	Fertiliser	Grain yield (t/ha)		Increasing to control	
		Control	Inoculation	T/ha	%
New cultivation	NPK 30:60:60, FYM:5t Lime:5t	15.6	17.8	2.2	114
Intercropped Rice-groundnut	NPK 30:60:60, FYM:5t Lime:5t	5.0	6.6	1.6	131
Intercropped Rice-groundnut	NPK 30:60:60, FYM:5t Lime:5t	6.1	6.5	0.4	106
Intercropped Vegetable-groundnut	100 kg SA, 70 kg KCl, 150 kg Coconut ash	14.1	16.95	2.85	120
Intercropped Vegetable-groundnut	NPK 30:60:60, FYM:5t Lime:500kg	14.7	16.3	1.7	111
Intercropped Vegetable-groundnut	NP:20:60, FYM:3t Lime:400kg	—	—	—	138
Intercropped Vegetable-groundnut	NPK 30:60:40, FYM:3t Lime:100kg	22.0	24.6	2.6	112

Source: Ngo The Dan et al. 2000

Table 6. Effect of Rh.inoculant on grain yield of groundnut fertilising different mineral N doses.

Fertilise	Pod/plant	Thickseed pod/plant	Pod yield (t/ha)
NPK 30:60:60, FYM 8t, lime 400kg	15.5	7.0	18.61
NPK 30:60:60, FYM 8t, lime 400kg +Inoculant	16.9	7.5	20.50
NPK 60:60:60, FYM 8t, lime 400kg +Inoculant	16.9	7.2	18.50
NPK 90:60:60, FYM 8t, lime 400kg +Inoculant	18.2	6.9	19.11

Source: Ngo The Dan et al. 2000

Legume Production in Vietnam

Legumes are traditional crops cultivated in Vietnam and play an important role in Vietnam's agricultural system. To enhance development of legume production, different policies are applied:

- To increase legume production areas and cultivation seasons to meet the increasing demand on legumes for internal consumption and exportation.
- To establish intensive legume cultivated zones in combination with the exploitation of local land available for legume cultivation.
- To stimulate the application of new technologies to legume cultivation, harvesting and processing.

The current status of legume production in Vietnam is shown in Tables 7 and 8. The dates indicate that the production of soybean and groundnut, the main legume crops growing in Vietnam has increased continuously in the past 5 years, caused by expanding the cultivated area and increasing the legume yield. Based on the soil type, climatic conditions and production tradition, there are 6 legume cultivated zones in the country. Legume growth area and yield in different zones are different, but they have the same tendency to increase from time to time. However, legume yield in Vietnam is still low compared to China or other Asian countries, where natural and climatic conditions are similar.

Table 7. Vietnam legume production in 1990–1998.

Legumes	Parameters	1990	1995	1998
Groundnut	Area (1000 ha)	201.4	259.9	269.4
	Yield (quintals/ha)	10.6	12.9	14.3
	Total production (1000 tons)	213.1	334.5	386.0
Soybean	Area (1000 ha)	110.0	121.1	127.8
	Yield (quintals/ha)	7.9	10.4	11.1
	Total production (1000 tons)	86.6	125.5	141.3
Other	Area (1000 ha)	133.0	187.5	221.5
	Yield (quintals/ha)	5.8	6.8	6.5
	Total production (1000 tons)	77.1	127.7	144.1

Source: Hoang Minh Tam 2001

Table 8. Legume production in different cultivated zones (1998).

No	Cultivated zones	Groundnut			Soybean			Other legumes		
		Area ***	Yield **	Production *	Area ***	Yield **	Production *	Area ***	Yield **	Production *
1	North mountains and midland	42.2	10.3	43.6	54.6	8.6	46.4	27.8	6.1	17.0
2	Red river delta	23.5	15.1	35.6	24.5	13.5	33.0	10.0	7.7	7.7
3	North middle Vietnam	71.1	13.1	93.4	3.3	10.0	3.3	30.8	3.4	10.5
4	Coastal area of south middle Vietnam	28.9	13.0	37.5	3.6	15.3	5.5	14.4	8.0	11.5
5	High land of Tay Nguyen	18.6	10.2	18.9	12.0	8.8	10.6	39.7	5.1	20.3
6	Southeast Vietnam	68.8	18.2	125.0	15.3	8.4	12.8	77.4	5.7	44.3
7	Cuu Long delta	16.3	19.6	32.0	14.5	20.5	29.7	21.4	15.5	33.2
8	Total	269	14.3	386.0	127.8	11.1	141.3	221.5	6.5	144.1

*: Area in 1000 ha **: Yield in quintals/ha ***: Production in 1000 tonnes/year

Source: Hoang Minh Tam 2001

Constraints of legume production in Vietnam are follows:

- The old policy concentrated only on increasing important food and industrial crop production and paid no attention to developing traditional crops like legumes, so that the production of legumes cannot meet the consumer or export demand.
- The perception of farmers on legume production is limited. They are not ready to cultivate legumes instead main food crops. Legumes can be grown only in the legume special zones or intercropped with other crops.
- High legume production costs and unstable markets are other reasons for the limited production of legumes in Vietnam.

At present, a program to develop legumes production in Vietnam has been established. Its purposes are:

- to increase legume production to meet the demand of nutrition for humans and for livestock production;

- to increase legume yield and decrease production costs by the application of new technologies and advances in legume cultivation, harvesting and processing.

The main program activities concentrate on:

- Increasing legume cultivation area—the production area will expand from 250,000 ha in 2001 to 330,000 ha in 2005 for groundnut and from 130,000 ha in 2001 to 500,000 ha in 2005 for soybean by establishing intensive legumes production zones, by rotation or intercropping with industrial crops (Tables 9 and 10).
- Increasing legumes yield and decreasing legume production cost—to increase legume yield, a new system for seed selection, processing and distribution is being established. In parallel, solutions to the problems of cultivation season, plan densities, fertiliser, irrigation, disease control and extension will be sought. The Vietnam Agricultural Science Institute has been nominated by the Vietnamese

government as the coordinator of two projects on improving soybean and groundnut production in Vietnam during the period 2001–2005. The total production will attain nearly 1,000,000 tonnes of soybean and 700,000 tonnes of groundnut in 2005. At the same time, the average yield of soybean and groundnut will reach 18 quintals/ha (Table 11).

Conclusion

Vietnam is an agricultural country with comfortable conditions for legume cultivation, but at present legume production cannot meet internal consumer demand. The Government of Vietnam will expand

legume cultivation areas in the next 5 to 10 years to increase legume production as human food, animal feed and to improve the soil. At present, legume production costs in Vietnam are high, caused by low yield. It is necessary to find a way to improve this situation. Rhizobium symbiosis is very beneficial for crops. Even though N-fixing research began in Vietnam more than 30 years ago, Rhizobium inoculant application is very limited.

In all of the country, no company is currently producing Rhizobium inoculant. A system of Rhizobium inoculant development, production, quality control, extension and distribution should be established to contribute to expanding legume production in Vietnam

Table 9. Expanding legume production area in Vietnam (ha).

Year	Groundnut	Soybean
2001	250,000	130,000
2005	330,000	500,000
2010	—	700,000

Source: Hoang Minh Tam 2001

Table 10. Soybean cultivation area in different production zones in Vietnam (1000 ha).

Production zones	Total area	Two rice cropped land	Once Rice cropped land	Soybean special land	Inter cropped land	Rotation land
North mountains and midland	140	120	—	20	—	—
Red river delta	150	4	42	83	18	3
North middle Vietnam	30	5	—	20	—	5
Coastal area of south middle Vietnam	30	—	—	25	—	5
High land of Tay Nguyen	110	—	—	97	10	3
Southeast Vietnam	85	9	1	60	11	4
Cuu Long delta	115	100	20	25	—	10
Total	700	238	63	330	39	30

Source: Hoang Minh Tam 2001

Table 11. Plan for legume production in Vietnam.

Year	Soybean		Groundnut	
	Yield (quintal/ha)	Total production (1000 t/year)	Yield (quintal/ha)	Total production (1000 t/year)
2001	12.5	187.50	15.00	375.00
2005	18.0	902.00	18.00	700.00

Source: Hoang Minh Tam 2001

References

- Ngo The Dan, Nguyen Xuan Hong, Do Thi Dung, Nguyen Thi Chinh, Vu Thi Dao, Pham Van Toan, Tran Dinh Long and C.L.L. Gowda 2000. Technologies to achieve high groundnut yields in Vietnam. Agriculture Publishing House, Hanoi, 2000.
- Tu Kien 2000. Some problems related to fertiliser utilisation and importation in Vietnam. National conference on IPNS, Hanoi, 11/2000.
- Hoang Minh Tam, 2001. Project to expanding legume production in Vietnam. Unpublished data.
- Pham Van Toan 1999. General results of national project KHCN.02.06 for the period 1996–1998. Monthly journal of science, technology and economic management, 9/1999.