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EFFECT OF CO-INOCULANTS (BRADYRHIZOBIA AND PHOSPHATE SOLUBILIZING BACTERIA) LIQUID ON SOYBEAN UNDER RICE BASED CROPPING SYSTEM IN THE MEKONG DELTA

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ABSTRACT

Three experiments were carried out on three different provinces of the Mekong Delta viz., An Giang, Can Tho and Dong Thap to study the effect of bradyrhizobia (Bradyrhizobium japonicum) and phosphate solubilizing bacteria (Pseudomonas spp.) in liquid inoculant (s) on soybean. The treatments composed of different combination level of inorganic nitrogen fertilizer levels (namely 20, 40, 60 kg N/ha) and liquid inoculant (s) (Bradyrhizobium japonicum and/or Pseudomonas spp.) in comparison to conventional farmers' fertilizer level (80 N - 60 P_2O_5 – 30 K_2O kg/ha). The results showed that application of bradyrhizobia (Bradyrhizobium japonicum) and phosphate solubilizing bacteria (Pseudomonas spp.) liquid inoculants on soybean seed before sowing plus 20 kg N/ha enhanced the nodule number, fresh weight, dry weight of nodules, yield components and grain yield in comparison to conventional farmers' fertilizer level. Moreover, this cultural practice not only saved 40 – 60 kg N and 60 kg P_2O_5 kg/ha and also obtained higher economic efficiency in term of Marginal benefit Cost Ratio (MBCR) to an extent level of 43.98%.

Keywords: *Bradyrhizobium japonicum,* dry weight of nodule, grain yield, liquid inoculants, MBCR, *Pseudomonas* spp.*,* soybean,

INTRODUCTION

The beneficial micro-organisms, especially PGPR (Plant Growth Promoting Rhizobacteria), are grown in the simple, cheap media and they are mixed with the appropriate carriers to produce biofertilizers. Rhizobial inoculant was demonstrated its effect on soybean grown on the alluvial soil in the Mekong Delta in 1982 (Tran Phuoc Duong *et al.* 1984a and 1984b, Tran thi Ngoc Son *et al.* 2003, 2004 and 2005). A simple, cheap cultural practices (no-tillage, rice straw, moisture ash) supported good survival rhizobia and nodulation in the heavy clay, acid soil when soybean cultivated in the dry season in the Mekong Delta (Tran Phuoc Duong and Cao Ngoc Diep 1986) or vegetable soybean (Cao Ngoc Diep *et al.* 2002). Farmers could clearly improve profitability by reducing fertilizer N inputs from the current rates of 50 – 150 kg/ha to "starter" rates of <20 kg/ha and inoculating with high-quality rhizobial inoculation (Hiep *et al.* 2002). Co-inoculation with rhizobial inoculant and phosphate solubilizing micro-organisms increased seed yield of soybean cultivated in the alluvial soil (Nguyen Huu Hiep and Cao Ngoc Diep 2003; Nguyen Van Duoc and Cao Ngoc Diep 2004, Cao Ngoc Diep 2005a) even on high-yielding rice (Cao Ngoc Diep 2005b). The rhizobial inoculation for soybean before sowing is one of the popular cultivation in many Northern American, European and Australian countries since the peat is more available here, it is good carrier for good survival and growth of rhizobia. However, the peat is the scare source in the tropical areas, hence the biofertilizer is difficult to develop under this cases (Singleton *et al.* 2002). There are many other materials can be found to replace for peat as coir pit, sugar cane trash but they are not as good as peat because they could not help in growth and survival of rhizobia and good nodulation. However, the use of peat as a carrier is so bulky and costly for small-scale production, in spite of the use of liquid inoculant for

small system cultivation under tropical condition by directly mix it with soybean seeds and sown immediately that they are suitable, cheap. The optimum combination of inorganic and bio-fertilizer as well as their effectiveness for upland crops rotation with rice in the form of power have been studied in details last year, 2005. However, the biofertilizer in the form of liquid (fast multiplication bacteria) has not been studied so far. In this present, we have studied to evaluate the effect of Bradyrhizobia and Pseudomonads on soybean nodulation, yield components and grain yield of soybean and their effects on soil fertility, soybean production cost, reducing environmental pollution as well as increase farmers' income in the sustainable agriculture.

MATERIALS AND METHODS

Bradyrhizobial inoculant liquid

Bradyrhizobium japonicum (USDA 110 strain) for soybean was grown in the G6 medium with 2% PVP [polyvinyl pyrrolidone] (Singleton *et al.* 2002) in four days on rotary shaker and population reaches $>10^9$ cells/ml, bradyrhizobial liquid in plastic bottles and stored at room temperature.

Phosphate solubilizing bacteria inoculant liquid (PSB liquid)

Pseudomonas spp. (P18 strain) was isolated from soybean rhizosphere soil and was determined high soluble phosphate and IAA (Diep and Phong, 2006, unpublished data). It was grown in sucrose apatite medium (Whitelaw et al. 1999) in 7 – 10 days and population reached >109 cells/ml, pseudomonad liquid in plastic bottles and stored at room temperature.

Soybean cultivars and soil characteristics

MTĐ-176 soybean cultivar was received from Department of Genetics, College of Agriculture and Applied Biology, Cantho University, this cultivar was used at site 1 and site 2 (see below), it has short life cycle (85-87 days), big seed size (100-seed weight approx 17-19 g), high grain yield and good pest resistance; Nhat ban 17A soybean cultivar has cultivated popularly in Dong Thap province (site 3) and this cultivar also has short life cycle (84-86 days), medium seed size (100-seed weight approx 16 -17 gram), high grain yield and good pest resistance. The soils have been intensively cropped with high-yielding rice at least twice a year. The physical and chemical characteristics of experimental soils were presented in Table 1;

Table 1. Physical and chemical characteristics of experimental soils *

Soil parameter	An Giang (Site 1)	Can Tho (Site 2)	Dong Thap (Site 3)
pH	5.564	5.866	4.486
Available N (ppm)	22.78	43.22	16.45
Available P (ppm)	8	8.8	5.2
Available K (ppm)	78.80	116	74.80
Organic matter (%)	1.709	2.392	2.098

*Soil samples were analyzed at Department of Soil Science, Cuulong Delta Rice Research Institute, Co Do district, Can tho city

Three experiments were carried out at three sites: Phu Thien hamlet, Phu Hoa village, Thoai Son district, An Giang province (site 1), Experimental Station of Cuulong Delta Rice Research Institute, Truong Thanh village, Co Do district, Can Tho city (site 2), Binh Hiep A hamlet, Binh Thanh Trung village, Lap Vo district, Dong Thap province (site 3). Three experiments were done in the Spring-Summer 2006. There were eight treatments follow as Table 2

Table 2. Eight treatments of experiment

Name	Fertilizer (kg/ha)
T1	0 N – 0 P_2O_5 -30 K_2O
T2	20 N + bradyrhizobia liquid (4litres /ha) + 60 P_2O_5 - 30 K_2O
T3	40 N + bradyrhizobia liquid (4 litres /ha) + 60 P_2O_5 - 30 K_2O
T4	60N + bradyrhizobia liquid (4litres /ha) + 60 P_2O_5 - 30 K_2O
T5	20N + bradyrhizobia liquid (2litres/ha) + pseudomonads liquid (2litres/ha) + 30 K_2O
T6	40N + bradyrhizobia liquid (2litres/ha)+ pseudomonads liquid (2litres/ha) + 30 K_2O
T7	60 N + bradyrhizobia liquid (2litres/ha) + pseudomonads liquid (2litres/ha) + 30 K_2O
T8	80 N - 60 P_2O_5 - 30 K_2O

Each experiment had three replications in a randomized completely block design, each treatment was a plot size of 50 m^2 (5m x 10 m) and 30 kg K_2O/ha was broadcasted in each experiment.

Before soybean planting in all experiments, rice straw was cut at the soil surface and it was used for mulching to prevent from water evaporation with zero land preparation. Soybean seeds were mixed with liquid inoculant(s) (Bradyrhizobial liquid 2litres/ha; PSB fertilizer 2 litres/ha), where applicable. Holes of about 2.5 cm in diameter and 2.5-3.0 cm deep were made by pointed poles and spaced 15 cm apart with the rows. Three soybean seeds were dropped into each hole and the hole was filled with moisture ash; plot size was 5x10 m with the spaced at 40 cm and interrows spaced at 15 cm, the final population of soybean plants was 500,000 plants/ha. After sowing seeds, phosphorus (as super phosphate 15% P_2O_5) and potassium (KCl 60% K_2O) fertilizers were band dressed to seed rows, where applicable; nitrogen was applied in increasing rates 0, 20, 40, 60 and 80 kg N/ha as urea (46% N) at 10 days after sowing (DAS) depending on treatments. Soybean plants were watered twice a day with skinler-can, weed control by hand and plants were protected with liquid insecticides when necessary.

All plant samples in all experiments were taken by randomized digging of five plants in central portion within guard rows and 0.5 m from each end of each plot. The first sampling was done when 80% of the plants had flowers for nodulation (nodule number and dry weight (DW) of nodule) and the second sampling when 80% of the plants had reached ripening stage for yield component and grain yield. After harvesting, soil samples were collected for evaluating initial analysis: soil samples were air-dried and sieved out of 2-mm sieve to determine nitrogen (micro-Kjeldahl method) and phosphorus content (Oniani method); plant samples were also dried at 70^oC in 24 hours, ground and determine nitrogen and phosphorus content.

An analysis of variance was done on data obtained from each parameter of three experiments. Treatment means were processed by Duncan test.

RESULTS AND DISCUSSION

Soybean nodulation

The number of nodules/plant ranged from 25.8 to 33.9; 6.7 to 18.3 and 18.7 to 30,.,2 for site 1 (An Giang), site 2 (Can Tho) and site 3 (Dong Thap), respectively. At all of sites, Bradyrhizobia and Pseudomonas increased the number of nodules/plant (T5 and T6) and the lowest nodule number/plant in T1 treatment (without inorganic nitrogen and phosphorus fertilizer) (Table 3), this led to the same fresh weight (FW) and dry weight (DW) of nodule.

Table 3. Effect of co-inoculation on soybean nodulation at 3 sites

Treat.	Nodule number/plant			Nodule fresh weight/plant (g)			Nodule dry weight/plant (g)		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
T1	25.8 c	6.70	18.7 c	1.51 c	0.463 d	0.64 d	0.31 c	0.016 d	0.16 e
T2	30.6 ab	10.5	25.7 b	1.65 ab	0.587 cd	0.75 c	0.35 ab	0.024 cd	0.20 d
T3	31.0 ab	9.7	26.6 b	1.68 ab	0.680 bcd	0.81 b	0.37 ab	0.028 bc	0.22 c
T4	29.7 abc	14.3	25.8 b	1.72 ab	0.943 b	0.80 b	0.38 a	0.039 b	0.24 b
T5	32.5 a	18.3	30.0 a	1.75 a	1.777 a	0.94 a	0.38 a	0.074 a	0.26 a
T6	33.9 a	11.0	30.2 a	1.75 a	0.733 bc	0.96 a	0.38 a	0.030 bc	0.27 a
T7	32.5 a	10.6	27.4 ab	1.71 ab	0.590 cd	0.92 a	0.37 ab	0.025 cd	0.23 bc
T8	28.2 bc	7.07	23.9 b	1.61 bc	0.52 cd	0.78 bc	0.34 bc	0.022 cd	0.19 d
F test	**	***	***	**	***	***	**	***	***
C.V (%)	7.1	18.0	7.0	3.5	19.2	3.3	5.0	20.4	4.4

* Means followed by the same letter (s) are not significantly different at 5% level based on DMRT

Soybean yield component

Plant height of soybean ranged from 53.6 to 78.2 cm; 52.6 to 73.7 cm and 46.5 to 61.1cm at site 1, site 2 and site 3, respectively. In site 1, there was no significant different among the treatments. In site 2 and 3, the lowest value obtained under T1 and the highest one obtained under high dose inorganic fertilizer T8. The total number of pods/plant ranged from 16.0 to 34.1; 16.6 to 22.1 and 15.0 to 29.9 for An Giang, Can Tho and Dong Thap, respectively. In site 1, T6 and T7 treatments had the highest pod number/plant under treated by Bradyrhizobia and Pseudomonads and there was significantly differences in comparison to conventional fertilizer treatment [T8] (80 N - 60 P_2O_5 - 30 K_2O) at 1‰ level. In site 2, there was no significantly different between treatments. In site 3, soybean pod number/plant under treated by Bradyrhizobia and Pseudomonads was equivalent with the T8 treatment (Table 4). The 1-seed/plant ranged from 2.17 to 4.00; 1.30 to 3.41 and 1.10 to 2.10 at site 1, 2 and 3, respectively. There was no difference in this parameter in site 1 and site 3 but in site 2, the lowest 1-seed pod/plant in T5 treatment (1.30) and the highest value obtained under T1 treatment (3.41). The number of 2-seed pod/plant ranged from 5.20 to 13.80, 9.33 to 12.70 and 7.27 to 9.17 at site 1, 2 and 3, respectively. In this parameter, there was no significant differences between treatments in site 2 and site 3 but the T4, T5, T6 and T7 treatments had the highest 2-seed pod/plant in site 3 with the highest value was recorded by treatment T7 (13.8) and lowest at treatment T1 (5.2). The number of pods having 3-seeds/plant ranged from 7.13 to 16.50; 2.43 to 7.53 and 4.93 to 19.20 at site 1, 2 and 3, respectively. At site 1, the highest value was recorded by T6 treatment and differed significantly with T1 and T8 treatment. Among the treatments, the lowest 3-seed pod/plant value obtained under control treatment (T1) and this result also appeared in site 2 and site 3 at 1‰ level. At three sites, co-inoculation with Bradyrhizobia and Pseudomonads increased the number of 3-seed pod/plant and this can contribute to the grain yield of soybean

The no-seed pods percentage was recorded from 3.02 to 9.39; 1.84 to 8.55 and 2.25 to 8.91 at site 1, 2 and 3, respectively and there were significantly different among treatments at 1%o level. Among the three experimental sites, the no-seed pod/plant was the highest in control treatment (T1) and lowest value was T6 treatment (Table 3) and the parameter contributed to yield component and grain yield. The 100-seed weight change from 18.6 to 19.9; 17.1 to 18.4 and 15.8 to 16.7 at site 1, 2 and 3, respectively. There was no significant difference among treatments at three sites.

Table 4. Effect of co-inoculation on soybean yield component at 3 sites

Treat.	Pod number/plant			No-seed pod/plant (%)			3-seed pod/plant		
	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3	Site 1	Site 2	Site 3
T1	16.0 e	16.6	15.0 c	9.39 a	8.55 a	8.91 a	7.13 d	2.43 d	4.93 d
T2	29.3 d	18.5	26.2 b	4.68 bcd	5.57 b	3.82 b	12.8 c	3.64 cd	16.1 c
T3	30.5 bcd	20.6	28.6 ab	4.48 cd	4.16 c	3.19 b	14.0 bc	5.19 bc	17.4 bc
T4	30.5 bcd	20.7	29.3 ab	5.48 bc	3.93 c	2.79 b	12.9 c	6.09 ab	17.8 bc
T5	32.3 abc	20.7	29.8 a	3.61 cd	3.46 c	2.46 b	14.4 bc	6.16 ab	19.0 ab
T6	34.1 a	22.1	28.3 ab	3.02 d	1.84 d	2.25 b	16.5 a	7.53 a	20.3 a
T7	33.4 ab	21.8	29.9 a	3.78 cd	3.85 c	2.35 b	15.1 ab	6.46 ab	19.2 ab
T8	30.2 cd	20.4	26.7 ab	6.67 b	4.75 bc	4.36 b	13.9 bc	5.83 b	16.4 c
F test	***	ns	***	***	***	***	***	***	***
C.V (%)	5.9	12.3	7.6	23	16.9	32.1	8.3	17.9	8.2

* Means followed by the same letter (s) are not significantly different at 5% level based on DMRT

Grain yield of soybean

At site 1, table 5 showed that the T5 treatment (2,526 kg/ha), T6 treatment (2,611 kg/ha), T7 treatment (2,486kg/ha) had the highest grain yield and they were significantly different T8 treatment (1,972kg/ha) at 1‰ level. T2 (1,847kg/ha), T3 (1,986kg/ha), T4 (2,042kg/ha) treatments had grain yield equivalent high treatment T8.

At site 2, T5 treatment (2,461 kg/ha) had highest grain yield and it was significantly difference to the highest inorganic fertilizer T8 treatment (1,971 kg/ha). The T2 (1,877 kg/ha), T3 (1,852 kg/ha), T4 (2,241 kg/ha), T6 (2,188 kg/ha), T7 (2,250 kg/ha) treatments did not differ with grain yield of T8 treatment. This result indicated that under alluvial soil condition, the amount of 20 - 40 kg N and 60 kg P_2O_5/ha could affect to biofertlizer for soybean production in the Mekong Delta. At site 3, the grain yield strongly varied from 1,111 to 2,455 kg/ha, the highest grain yield of soybean was T6 treatment (2,456 kg /ha). Co-inoculation with liquid inoculant containing Bradyrhizobia and Pseudomonads supplementing 40 kg N/ha enhanced the grain yield of soybean in comparison to Bradyrhizobia liquid inoculant alone as T2 (1,889 kg /ha), T3 (1,900 kg/ha), T4 (1,989 kg/ha), T5 (2,078 kg /ha), T7 (2,344 kg/ha) or control treatment T1 (1,111 kg/ha) and application of liquid inoculant with two bacteria into soybean seeds before sowing increased grain yield from 9.33% to 14.60 % as compared to T8 treatment.

Table 5. Effect of co-inoculation on grain yield (kg/ha) of soybean cultivated on alluvial soils of An Giang (site 1), Can Tho (site 2) and Dong Thap (site 3) in spring-summer cropping-season 2006

Treatment	Site 1	Site 2	Site 3	Average of 3 sites
T1	1,153 c	1,152 d	1,111 d	1,138 d
T2	1,847 b	1,877 c	1,889 c	1,871 c
T3	1,986 b	1,852 c	1,900 c	1,912 c
T4	2,042 b	2,241 ab	1,989 c	2,090 ab
T5	2,528 a	2,460 a	2,078 bc	2,355 ab
T6	2,611 a	2,188 abc	2,456 a	2,418 a
T7	2,486 a	2,250 ab	2,344 ab	2,360 ab
T8	1,972 b	1,970 bc	2,144 bc	2,028 bc
F test	***	***	***	***
C.V (%)	7.7	10.4	8.1	6.81

* Means followed by the same letter (s) are not significantly different at 5% level based on DMRT

In Table 5, presented average of grain yield of 3 sites, T6 treatment had the highest grain yield and it differed from grain yield of T8 treatment significantly, therefore soybean planting on alluvial soils applying with Bradyrhizobia and Pseudomonads liquid plus 40 kg N/ha was better than soybean only applying inorganic fertilizers (80 kg N – 60 kg P_2O_5/ha), especially co-inoculation increased total of pod number/plant and decreased no-seed pod/plant and two these components enhanced grain yield (Fig 1 and Fig 2).

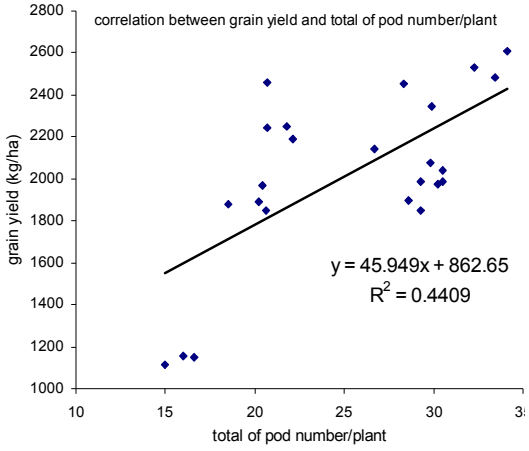

Figure 1. Correlation between total of pod/plant with grain yield at 5% level

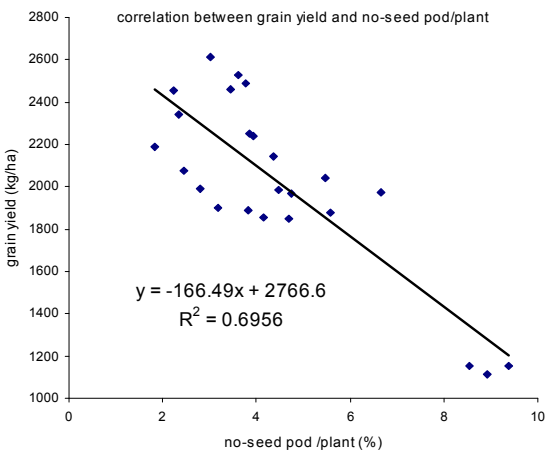

Figure 2. Correlation between no-seed pod/plant with grain yield at 1% level

Soil available nutrients

At the harvesting time of soybean, the available N and P has been increased significantly under application of biofertlizer whether only bradyrhizobial inoculant or both bradyrhizobial inoculant and PSB fertilizer as compared to farmers' practices level.

Soil available nitrogen: At An Giang (site 1) the soil available nitrogen increased from 14.91 % to 19.02 % , at Can Tho (site 2) the soil available nitrogen has increased from 1.66 % to 2.17 %, and at site 3 (Dong Thap) the soil available nitrogen increased from 12.20% to 17.13%.

Soil available phosphate: At An Giang (site 1), soil available P under T4, T5 and T6 were on a par with the T8. At Can Tho (site 2), soil available P under T5, T6 and T7 were on a par with the T8. Whereas at Dong Thap (site 3), soil available P recorded significantly higher value under treated plots as compared to the T8. Soil available potassium got no significantly different at 2 sites *viz.,* An Giang and Can Tho (Table 6).

Table 6. Effect of treatments on soil available nutrients (ppm) of grown soybean at harvest stage (2006 Spring–Summer)

Treatment	An Giang (site 1)			Can Tho (site 2)			Dong Thap (site 3)		
	N	P	K	N	P	K	N	P	K
T1	25.73 c	6.67 c	88 b	45.50d	8.67 c	117 b	23.53e	4.67 c	90 b
T2	30.05bc	9.33 bc	98 ab	55.47bc	10.67bc	123 ab	38.40d	8.67ab	123 a
T3	33.81 b	9.33 bc	103ab	54.06c	10.67bc	128ab	44.85cd	9.33ab	130 a
T4	33.81 b	11.33ab	109 a	55.55bc	12 ab	127ab	45.63bcd	8.67ab	134 a
T5	40.62 a	12.67 a	113 a	61.10ab	12.67ab	131ab	52.14abc	10.67a	133 a
T6	39.22 a	10.67ab	112 a	64.51a	13.33a	133ab	54.43 a	10.67a	135a
T7	34.13 b	9.33 bc	113 a	64.19a	12.67ab	135 a	53.17ab	10 a	138 a
T8	34.13 b	10.00ab	115 a	63.14a	12.00ab	132 ab	46.47abcd	7.33b	131 a
F test	***	*	ns	***	*	ns	***	**	***
CV (%)	8.5	17.3	11.2	5.9	12.8	8	10.5	15.5	7.2

Means followed by the same letter(s) are not significantly different at 5% level based on DMRT

Nutrient uptake by soybean grain

The data presented in the table 8 showed that at site 1 (An Giang) recorded the nutrient uptake by soybean grain increased from 10.41 to 37.07 % and from 28.19 to 38.18% for N and P, respectively (Table 8). The experimental result at Can Tho province showed that nutrient uptake by soybean grain increased from 11.92 to 23.99 % and from 7.02 to 21.93% for N and P, respectively. In case of Dong Thap, the nitrogen uptake increased from 12.12 to 17.82 % and phosphorus increased from 12.10 to 13.71 % under application of bio-fertilizer (bradyrhizobial inoculant and PSB fertilizer) as compared to farmers' fertilizer level (uninoculation)

Table 8. Effect of treatments on nutrient uptake (kg/ha) of grown soybean at harvest stage (2006 Spring-Summer)

Treatment	N uptake (kg/ha)			P uptake (kg/ha)		
	Site 1 (An Giang)	Site 2 (Can Tho)	Site 3 (Dong Thap)	Site 1 (An Giang)	Site 2 (Can Tho)	Site 3 (Dong Thap)
T1	59.4d	62.9d	56.9e	5.64c	5.67d	5.65e
T2	100.6c	119.9c	105.7d	10.4b	10.0c	9.78d
T3	110.6bc	118.5c	107.7d	11.3b	10.0 c	10.7cd
T4	118.0b	143.6abc	109.9cd	11.3b	12.2abc	11.0bcd
T5	145.3a	156.1a	121.4cd	15.2a	13.9a	11.7bc
T6	155.3a	140.9abc	146.8a	14.9a	12.8ab	14.1a
T7	143.0a	146.5ab	139.7ab	14.1a	13.3ab	13.9a
T8	113.3bc	125.9bc	124.6bc	11.0b	11.4bc	12.4b
F test	***	***	***	***	***	***
CV (%)	8.2	11.9	8.2	13.3	12.2	7.2

Marginal Benefit Cost Ratio

At 3 sites *viz.,* An Giang, Can Tho and Dong Thap: the experimental results showed that under application of co-inoculants (Bradyrhizobia and phosphate solubilizing bacteria) liquid on soybean whether alone or combination recorded the higher MBCR as compared to farmers' fertilizer level (treatment T8). Application of biofertlizer as bradyrhizobial inoculant or both bradyrhizobial inoculant and BSP fertilizer increased the MBCR of soybean production to an extent of 2.4 to 52.41 %, 14.57 to 46,36 and 17.79 to 33.17 % for site 1, site 2 and site 3, respectively compared to high inorganic fertilizer level (T8). Among the treatments, the treatment T5 had the highest MBCR at site 1 and site 2 (Fig. 3 and Fig. 4). Whereas, under site 3, the treatment T6 offered the highest MBCR (Fig. 5)

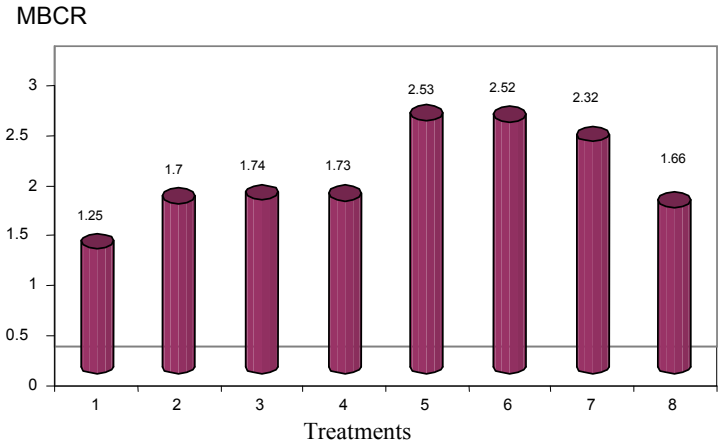

Figure 3. Effect of co-inoculants liquid on MBCR at site 1 (An Giang)

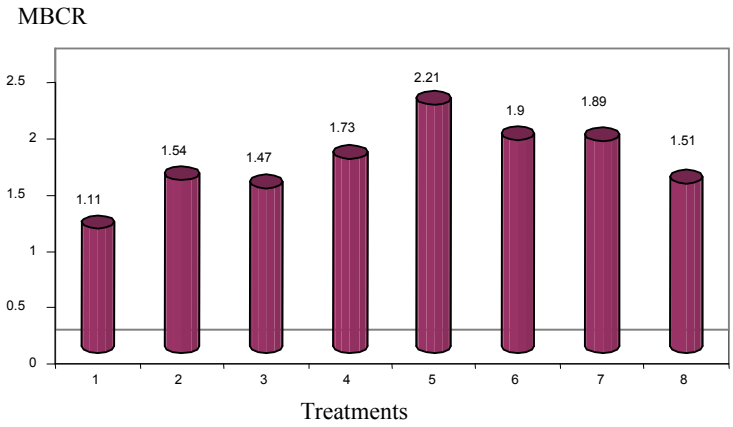

Figure 4. Effect of co-inoculants liquid on MBCR at site 2 (Can Tho)

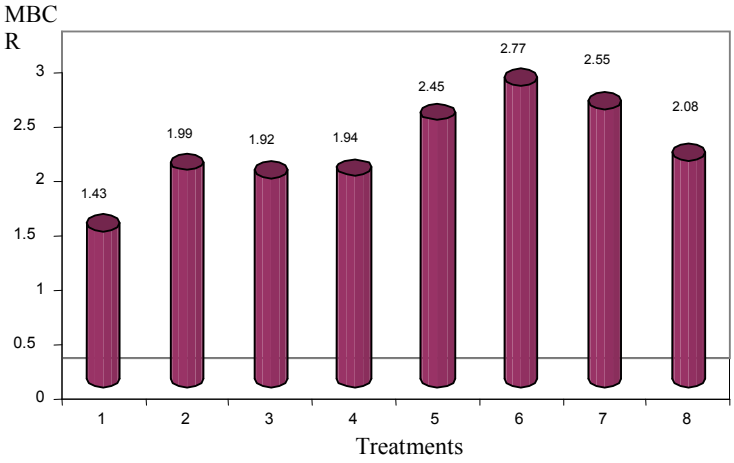

Figure 5. Effect of co-inoculants liquid on MBCR at site 3 (Dong Thap)

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Hiệu quả chủng vi khuẩn nốt rễ và vi khuẩn hòa tan lân (dạng lỏng) trên đậu nành trồng trên đất phù sa ở Đồng bằng sông Cửu Long

Phân vi sinh chủng dạng lỏng có ưu thế nhân nhanh mật số các vi sinh vật có ích đồng thời có triển vọng giảm được chi phí phân bón nhiều hơn so với phân vi sinh chủng dạng bột. Nhằm mục đích xác định hiệu quả của loại phân này ba thí nghiệm ngoài đồng được thực hiện trên đất phù sa tại 3 tỉnh ở Đồng bằng sông Cửu Long là An Giang, Cần Thơ và Đồng Tháp để khảo sát hiệu quả chủng vi khuẩn nốt rễ và vi khuẩn hòa tan lân dạng lỏng cùng với phân hoá học trên đậu nành luân canh với lúa cao sản trên năng suất, độ phì và hấp thu dinh dưỡng cho cây đậu nành. Kết quả thí nghiệm cho thấy hai nhóm vi khuẩn có ích này gia tăng số nốt rễ, thành phần năng suất, năng suất hạt đậu, giảm được khoảng 40 - 60 kg N/ha và 60 kg P_2O_5/ha và năng suất đậu nành có chủng vi sinh vật có ích cao hơn hoặc tương đương với đậu nành chỉ bón phân hoá học theo công thức của nông dân (80 N - 60 P_2O_5 – 30 K_2O kg/ha). Ngoài những lợi ích trên nông dân còn có thể thu được tỷ suất lợi nhuận biên tế cao hơn đến mức 43,98% .