Biodiversity of VA mycorrhizal fungi and their effect on leguminous plant communities in Thailand

OMSUB NOPAMORNBODI , SIRIVIPA SAJJAPONGSE , SOMPETCH CHAROENSOOK
Department of Agricuture , Bangkok , Thailand

The collection and isolation of VA mycorrhizal fungi from leguminous planting area.Thus are 254 strains from 177 collected soil samples which having pH from 4.0 – 8.5.The VAM genus found were *Acaulospora*, *Glomus*, *Gigaspora*, *Scutellospora*, *Entrophospora* and *Sclerocystis*, the amount of spores found varied from 2 – 1200 spores per 100 gram of collected soils. The amount of spores were found highest in the soil pH 6 and available P 100 ppm. The collected strains were tested for their effectiveness on sporulation and infectivity in plant. Amount of 37,000 spores per hundred gram soil were found in the effective strain with 53.3 percent root infection.Hundred percent of root infection were found in many strains of genus *Glomus* and *Acaulospora.* Ten strains of these VAM were selected to test for there effectiveness on growth of *Glycine max* and *Sesbania gladiflora* These VAM increased plant growth more than control.

Introduction

VA mycorrhizal (VAM) fungi , obligate symbionts of plant roots , are dominant association in agriculture cropping system.Their role indicate their effectiveness on promoting plant growth including leguminous plant and fast growing tree (Kendrick 1992 , Brundett 1991).So this experiment will collected the VAM strains from the area

growing leguminous plant and selected the effective strains which can promote growth of leguminous plant.All strains collected will be tested for their sporulation and infectivity efficiency , and the efficacy for promoting growth of *Glycine max* and *Sesbania gradiflora.*

Materials and Methods

Sample collection

Soil samples were collected from the leguminous plant growing area.One kilogram of soil in each sample was collected at the depth 30 – 50 cm.Six composite samples were collected to represent soil sample of each site and kept in plastic bag in the room temperature around 2 – 5 °c.The wet soil samples were air dried in room temperature before keeping.These soil samples were extracted to separate spores for testing the efficiency in sporulation and infectivity.

Counting spore propagules in soils

VA mycorrhizal spores were extracted from soil sample by wet seiving and decanting as described by Gerdemann (1963) and sucrose centrifugution by Smith & Skipper (1979).One hundred gram of soil sample were suspended in one litre of water by gentle stirring.Heavier particles were allowed to settle for a few seconds and the liquid was decanted through a 450 micron seive to remove the large particles of organic matter and allow the spores pass through.The suspension was passed again through 100 micron seive.The spores and small amount of debris remain on 63 micron seive were poured into centrifuge tube containing water , centrifuged at 1,800 rpm.The upper solution was poured , the debris at the

bottom was added with 40% sucrose and centrifuged for 2 minutes at 1,800 rpm.The upper solution was seperated to examine under the stereoscopic microscope.The spores which were collected under the microscope were stored in Ringer's solution for identification.

Identification of VAM

Extracted spores from each soil sample were divided into group of the same characteristics for identification.The identification in this study followed the monograph and the manual of Gerdemann & Trappe (1974) Hall (1984) Trappe and Schenck (1982) separate the spores into different genus by the spore attachment , size and color of spores .The semipermanent slides were prepared , semipermanent mountant , PVL (polyvinyl alcohol + lactic acid + Glycerol) were used.This mountants effected same certain spore characteristics , such as wall characteristics and spore color , spore diameter , attachment present , spore content etc.The classified spores will be multiplied in pot culture effectiveness of VAM in the host plant.

Soil samples characteristics

The collected soil samples were measured the soil pH and will be analysed for available phosphorus by Bray II

Effectiveness of selected VAM on plant

Ten strains of VAM were selected to test for their effectiveness on growth of *Glycine max* and *Sesbania gladiflora* , The experiment were employ in Randomized Complete Block Design with 4 replications and 11 treatments , Ten strains of VAM compare with noninoculated. The data was statistically analysed by Duncan Multiple Range Test.

Results and Discussions

One hundred and seventy seven soil samples were collected in the leguminous plant area.Soil pH and available P including amount of spores are shown in Table 1.The spores were collected from the soil growing the following plants.

- *Acacia auriculaeformis*
- *Acacia tomentosa*
- *Acacia tomentosa*
- *Acacia pennata*
- *Clitoria ternatea*
- *Sesbania gradiflora*
- *Pterocarpus macrocarpus*
- *Xylia xylocarpa*
- *Poltohorum dasyrachis*
- *Bauhinia spp.*
- *Vigna sinensis*
- *Vigna sinensis*
- *Pisum sativum*
- *Pithecellobium bulce*
- *Leucaena leucocephala*
- *Acacia auriculaeformis*
- *Sesbania gradiflora*
- *Epythrina stricta*
- *Pithecellobium jiringa*
- *Pterocarpus macrocarpus*
- *Afzelia xylocarpa*
- *Cajanus fistula*
- *Samanea saman*
- *Glycine max*
- *Arachis hypogaea*
- *Cajanus cajan*
- *Tamarindus indica*

Two hundred and fifty four VAM strains were collected from leguminous growing area.Six genera of VAM; *Glomus , Acaulospora, Gigaspora, Sclerocystis, Entrophospora* were found.The highest amount of spores were found 1,200 spores / 100 gram soil from the soil growing *Acacia auriculaeformis* in Chanthaburi province.The soil having pH 5.8 and available P 4 ppm.(Fig 1&2) From the graph 1 and 2 showed that highest amount of spores were found in soil pH 6 and available P 100 ppm.The least amount of spores

were found in soil pH 9 and available P 350 ppm.The collected strains were tested for their effectiveness in sporulation and infectivity, it was found that *Acaulospora sp.* DAPR 5001 produce highest amount of 25,960 spores in 100 gram soil and 53.3% of root infection (Table 1).No sporulation was found in *Sclerocystis sp.* and *Entrophospora sp.*

All strains tested for their effectiveness on leguminous plant showed the increasing growth to *Glycine max* and *sesbania gladiflora* over non inoculated as shown in table2 and table3.

Conclusion

From the survey in the leguminous plant growing area in Thailand , 254 isolates of VA mycorrhizal fungi has been collected from 177 composite soil samples.The genus identified were *Acaulospora*, *Glomus*, *Gigaspora, Scutellospora, Entrophospara* and *Sclerocystis. Acaulospora* produced highest amount of spores in the host plant followed by *Glomus*, *Gigaspora* respectively.No sporulation was found in *Sclerocystis* and *Entrophospara* and all strains tested for their effectiveness on leguminous plant showed the increasing growth to *Glycine max* and *sesbania gladiflora* over non inoculated.

References

Brundrett , MC.1991.Mycorrhizal in natural ecosystems.In : Macfayden A , Begon M &
Fitter AH (ed.), Advance in Ecological Research , Val.21.Academic Press ,
London , 171-313.

Gerdemann , J.W. and T.H. Nicolson , 1963.Spores of Mycorrhizal Endogone extracted

from soil by wet seiving and decanting .Trans.Br.Mycol.Soc.46:235-244.

Kendrick , B. 1992.The Fifth Kingdom.Mycologue Publications Ltd.Waterloo *.

(*address for orders : 8727 Lochside Drive , Sidney , BC Canada , VBL 1 M8)

Smith , G.W. and H.D. Skipper.1979.Comparison of method to extract spores of

vesicular arbuscular mycorrhizal fungi.Soil Sci.Soc.Amer.J.43:722-725.

Table 1 Amount of VAM spores and percent root infection in Nutrifeed grasses inoculated by collected VAM

Soil code	Strain code	VAM	Description	Collected sample spores / 100 gm soil	Multiplied sample spores / 100 gm soil	Root Colonization (%)
PR1	DAPR 5001	*Acaulospora*	globose , hyaline , pale green , pitted-spore surface 151 x 157 µ	250	25960	53.33
PR2	DAPR 5004	*Gigaspora*	globose , hyaline , white , pink , white suspensor 233 x 236 µ	7	629	6.66
PR3	DAPR 5006	*Acaulospora*	globose , hyaline , pale green, pitted spore surface 164 x 172 µ	50	2582	15.00
NA1	DANA 5007	*Glomus*	globose , subglobose, yellow brown, straight attachment 126 x 132 µ	43	2547	6.66
NA2	DANA 5008	*Glomus*	globose , subglobose, yellow brown , straight attachment 128 x 132 µ	10	913	10.00
NA3	DANA 5011	*Acaulospora*	globose , hyaline ,	50	2844	63.33

			yellow 80 x 82 µ			
NA4	DANA 5015	*Glomus*	globose , subglobose , yellow brown , straight attachment 117 x 128 µ	55	1550	31.66
NA5	DANA 5016	*Glomus*	globose , subglobose , yellow brown , straight attachment 121 x 126 µ	50	1298	60.00
LA1	DALA 5017	*Acaulospora*	globose , hyaline 93 x 97.5 µ	50	363	60.00
UT1	DAUT 5018	*Glomus*	globose ,subglobose , yellow brown , straight attachment 121 x 130 µ	17	1353	60.00
PS1	DAPS 5019	*Acaulospora*	globose , hyaline , pale green , pitted-spore surface 134 x 141 µ	20	1600	100
PS2	DAPS 5020	*Gigaspora*	globose , hyaline	-	-	-
PC1	DAPC 5021	*Glomus*	globose , subglobose , ellipsoil , greenish , yellow brown , recurved , straight attachment 110 x 115 µ	37	5200	25.00
PC2	DAPC 5023	*Acaulospora*	globose , hyaline 83.5 x 88 µ	100	5500	81.66
PJ1	DAPJ 5024	*Glomus*	globose , red , yellow brown, branch attachment 229 x 236 µ	10	23	66.66
PJ2	DAPJ 5025	*Acaulospora*	globose , hyaline 83 x 87.5 µ	45	1463	95.00

* remark data shown only some significance strains

Soil code	Strain code	VAM	Description	Collected sample spores / 100 gm soil	Multiplied sample spores / 100 gm soil	Root Colonization (%)
PJ3	DAPJ 5026	*Glomus*	globose , irregular , yellow , straight , branched attachment 81.5 x 84.5 µ	100	1573	100
PJ4	DAPJ 5028	*Glomus*	globose , ovoid , brownish-yellow, funnel shape spore 172 x 183 µ	5	1077	56.66
PJ5	DAPJ 5031	*Acaulospora*	globose , hyaline 83 x 89 µ	207	12888	43.33
RB1	DARB 5032	*Glomus*	globose , subglobose , ellipsoil greenish , yellow brown , recurved , straight attachment 116 x 123 µ	110	5423	31.66
RB2	DARB 5033	*Glomus*	globose , subglobose , yellow brown , straight attachment 106 x 111 µ	-	-	-
CB1	DACB 5036	*Acaulospora*	globose , hyaline , yellow , 129 x 135 µ	100	286	3.33
PJ6	DAPJ 5037	*Glomus*	globose , subglobose , yellow brown , straight attachment 105 x 113 µ	100	380	83.33
PJ7	DAPJ 5038	*Glomus*	globose , subglobose , yellow brown , straight attachment 114 x 117 µ	100	1900	76.66
PR4	DAPR 5039	*Acaulospora*	globose , hyaline , yellow , pitted-spore surface 107 x 111 µ	350	3245	40.00
BK1	DABK 5041	*Glomus*	globose , subglobose , ovoid irregular , yellow , branch , straight attachment 146 x 155 µ	123	500	86.60

BK2	DABK 5042	*Glomus*	globose , irregular , hyaline , straight , recurved attachment 125 x 130 µ	12	57	36.66
BK3	DABK 5048	*Glomus*	globose , irregular , hyaline straight , recurved attachment	10	0	0
BK4	DABK 5052	*Acaulospora*	globose , hyaline 75 x 83.5 µ	40	5868	33.33
SK1	DASK 5053	*Acaulospora*	globose , hyaline	-	-	-
CM1	DACM 5054	*Gigaspora*	globose , white 346 x 356 µ	24	32	21.66
CM2	DACM 5058	*Acaulospora*	globose , hyaline 80 x 82 µ	50	2350	58.00
CM3	DACM 5059	*Glomus*	globose , subglobose , yellow brown , straight attachment 105 x 112 µ	130	7668	6.66
CM4	DACM 5060	*Acaulospora*	globose , hyaline 85 x 90 µ	100	2232	11.66
CM5	DACM 5062	*Acaulospora*	globose , hyaline 108 x 111 µ	50	2510	98.33

Soil code	**Strain code**	**VAM**	**Description**	**Collected sample spores / 100 gm soil**	**Multiplied sample spores / 100 gm soil**	**Root Colonization (%)**
CM6	DACM 5063	*Glomus*	globose , subglobose , yellow brown , straight attachment 80 x 84.5 µ	50	1785	98.33
CM7	DACM 5066	*Acaulospora*	globose , hyaline 83 x 86 µ	50	3170	60.00
CM8	DACM 5068	*Acaulospora*	globose , hyaline	-	-	-
CM9	DACM 5069	*Acaulospora*	globose , hyaline 110 x 114 µ	50	2100	63.33
CM10	DACM 5070	*Acaulospora*	globose , hyaline	50	1780	63.33
CM11	DACM 5072	*Acaulospora*	globose , hyaline	50	4200	76.66

CM12	DACM 5073	*Gigaspora*	globose , white	-	-	-
CM13	DACM 5075	*Acaulospora*	globose , hyalinem 85 x 93 µ	50	3510	100
CM14	DACM 5076	*Acaulospora*	globose , hyaline 87 x 91 µ	50	2750	100
CM15	DACM 5079	*Gigaspora*	globose , white	-	-	-
CM16	DACM 5081	*Gigaspora*	globose , yellow 372 x 386 µ	50	6	3.33
CM17	DACM 5084	*Glomus*	globose , subglobose , yellow brown , straight attachment 102 x 112 µ	100	12064	95
CM19	DACM 5086	*Gigaspora*	globose , yellow 307 x 324 µ	10	0	0
CM20	DACM 5089	*Gigaspora*	globose , yellow	10	0	0
CM22	DACM 5091	*Acaulospora*	globose , reddish , yellowish brown funnel hypha attachment 186x192 µ	10	350	48.33
CM23	DACM 5094	*Gigaspora*	globose , hyaline	-	-	-
CM24	DACM 5095	*Acaulospora*	globose , hyaline 110 x 128 µ	50	890	97.33
CM25	DACM 5096	*Glomus*	globose , subglobose , yellow brown , straight attachment 113 x 118 µ	320	6520	95
CM26	DACM 5097	*Acaulospora*	globose , hyaline	-	-	-
CM27	DACM 5099	*Glomus*	globose , subglobose , ellipsoil, yellow brown , straight , recurved attachment 108 x 109 µ	18	390	83.33
CM28	DACM 5100	*Acaulospora*	globose , ovoid , irregular , oblong , white , hyaline 81 x 86 µ	130	37000	100
CM29	DACM 5103	*Entrophospora*	globose , ovoid irregular , pale	10	264	13.33

			yellow , 120 x 125 µ			

Soil code	Strain code	VAM	Description	Collected sample spores / 100 gm soil	Multiplied sample spores / 100 gm soil	Root Colonization (%)
CM30	DACM 5106	*Glomus*	globose , subglobose , irregular , hyaline , straight , recurved attachment	-	-	-
CM32	DACM 5109	*Glomus*	globose , subglobose , yellow , straight attachment 98 x 109 µ	145	6368	20
CM33	DACM 5112	*Gigaspora*	globose , yellow 380 µ	10	0	0
CM36	DACM 5113	*Acaulospora*	globose , subglobose , hyaline 75 x 83 µ	74	1760	80
CM38	DACM 5116	*Acaulospora*	globose , hyaline 113 x 116 µ	10	3208	60
CM40	DACM 5117	*Acaulospora*	globose , yellow brown , brown 111 x 115 µ	100	546	88.30
CM42	DACM 5119	*Acaulospora*	globose , hyaline 78.5 x 83 µ	75	661	78.33
CM43	DACM 5122	*Glomus*	globose , subglobose , yellow brown , straight attachment 118 x 123 µ	50	5840	56.67
CM44	DACM 5123	*Acaulospora*	globose , pale brown 106 x 112µ	100	352	75
CM45	DACM 5124	*Glomus*	globose , brownish-yellow , greenish brown , straight attachment 86 x 93 µ	41	1062	8.33
CM46	DACM 5128	*Gigaspora*	globose , white 386 x 399 µ	40	20	3.33
CM47	DACM 5131	*Acaulospora*	globose , hyaline 103 x 109 µ	10	2130	48.33

UB4	DAUB 5132	*Acaulospora*	globose , hyaline 83 x 91 µ	50	990	66.66
SK11	DASK 5135	*Glomus*	ovoid , oblong , reniform , yellow brown , brown , straight attachment 173 x 189 µ	10	0	0
SK14	DASK 5136	*Glomus*	globose , hyaline , straight attachment 83.5 x 88.5 µ	30	1054	35
BK5	DABK 5137	*Glomus*	globose , subglobose , ellipsoil, greenish , yellow brown , straight - recurved attachment 104 x 113 µ	50	870	78.33
BK6	DABK 5139	*Acaulospora*	globose , hyaline 75 x 81 µ	100	2592	33.33
UB6	DAUB 5140	*Acaulospora*	globose , yellow brown , orange brown 165 x 172 µ	10	27	10
SK10	DASK 5144	*Glomus*	ovoid , pale brown , brown , straight attachment	20	0	0

Soil code	**Strain code**	**VAM**	**Description**	**Collected sample spores / 100 gm soil**	**Multiplied sample spores / 100 gm soil**	**Root Colonization (%)**
BK7	DABK 5145	*Glomus*	globose , subglobose , irregular , reniform , yellow , branched attachment 286 x 301 µ	50	75	63.33
BK9	DABK 5148	*Acaulospora*	globose , pale brown 109.5 x 115 µ	30	5005	18.33
BK11	DABK 5151	*Glomus*	globose , hyaline , straight , branched attachment	57	3773	3.33

			76.5 x 85.5 µ			
BK13	DABK 5152	*Gigaspora*	globose , white 250 µ	50	297	11.66
BK15	DABK 5154	*Glomus*	globose , subglobose , yellow brown , straight attachment 108.5 x 123.5 µ	50	2367	13.33
CB2	DACB 5155	*Glomus*	globose , irregular , hyaline , branch , straight attachment 78 x 87 µ	10	304	96.66
PC3	DAPC 5156	*Glomus*	globose , subglobose , yellow brown , straight attachment 104.5 x 110.5 µ	56	4576	61.66
CB4	DACB 5157	*Glomus*	globose , hyaline , straight , branched attachment 130 x 134.25 µ	50	200	43.33
PC4	DAPC 5158	*Gigaspora*	globose , hyaline 249 x 258 µ	60	52	15
PC5	DAPC 5159	*Acaulospora*	globose , yellow brown, funnel hypha attachment 137.5 x 141 µ	50	110	3.33
PC6	DAPC 5160	*Gigaspora*	globose , white 245 x 254 µ	100	506	26.66
PC7	DAPC 5162	*Glomus*	globose , ovoid , irregular , hyaline , yellow pale brown , branched , straight attachment 106 x 115 µ	10	136	33.33
CB5	DACB 5163	*Glomus*	globose , red brown , branched attachment 272 x 279 µ	10	0	0
CB6	DACB 5166	*Glomus*	globose , subglobose , yellow brown , straight attachment 117 x 125 µ	10	1248	20
CB7	DACB 5169	*Glomus*	globose , reniform , yellow , straight , recurved attachment	65	4488	63

			115.25 x 121 µ			
PC11	DAPC 5170	*Gigaspora*	globose , hyaline 237 x 247 µ	54	2178	70
PC14	DAPC 5172	*Gigaspora*	globose , yellow 340 x 358 µ	59	451	5
PC15	DAPC 5173	*Gigaspora*	globose , hyaline 217 x 225 µ	79	286	41.66
PC16	DAPC 5175	*Glomus*	globose , ovoid , brownish-yellow , funnel shape spore 162 x 167 µ	68	2299	45

Soil code	**Strain code**	**VAM**	**Description**	**Collected sample spores / 100 gm soil**	**Multiplied sample spores / 100 gm soil**	**Root Colonization (%)**
CB8	DACB 5176	*Acaulospora*	globose , hyaline 77 x 83.75 µ	20	11770	91.66
PC17	DAPC 5178	*Glomus*	globose , white , yellow , funnel- shape spore straight – recurved , branched attachment 193.5 x 201.5 µ	20	1100	10
PC18	DAPC 5179	*Acaulospora*	globose , hyaline , pale green pitted-spore shape 138.5 x 148.5 µ	80	274	11.66
PC20	DAPC 5181	*Gigaspora*	globose , white , pink 236 x 246.5 µ	100	506	18.33
PR5	DAPR 5182	*Glomus*	globose , brown , curved , straight attachment 121 x 128 µ	10	2904	16.66
PR6	DAPR 5186	*Glomus*	globose , subglobose , yellow brown , straight attachment 110 x 120 µ	10	56	3.33
LA2	DALA 5187	*Acaulospora*	globose , hyaline , pale green , pitted-spore surface 131 x 138 µ	10	312	6.66
LA3	DALA 5188	*Acaulospora*	globose , hyaline , pale green ,	50	1177	43.33

			pitted-spore surface 151 x 161 µ			
NA8	DANA 5189	*Acaulospora*	globose , reddish brown , yellowish brown, funnel hypha attachment 201 x 214 µ	20	407	70
PR8	DAPR 5192	*Glomus*	globose , subglobose , yellow brown , straight attachment 107 x 111 µ	10	208	6.66
LA4	DALA 5193	*Glomus*	globose , subglobose , yellow brown , straight attachment 104 x 113 µ	10	1136	8.33
PR10	DAPR 5194	*Glomus*	globose , subglobose , yellow brown , straight attachment	10	77	53.33
PR9	DAPR 5197	*Glomus*	globose , subglobose , yellow brown , straight attachment	50	220	71.66
LA5	DALA 5199	*Acaulospora*	globose , hyaline , pale green , 140 µ	20	120	11.66
NA9	DANA 5200	*Acaulospora*	globose , pitted-spore surface , pale yellow , 141 x 165 µ	70	3927	71.66
PR12	DAPR 5202	*Glomus*	globose , subglobose , yellow brown , straight attachment 106 x 114 µ			

Soil code	Strain code	VAM	Description	Collected sample spores / 100 gm soil	Multiplied sample spores / 100 gm soil	Root Colonization (%)
LA8	DALA 5203	*Glomus*	globose , ovoid, brownish-yellow , straight-funnel shape spore 159 x 160 µ	50	1199	100
LA9	DALA 5206	*Glomus*	globose , subglobose , yellow brown , straight attachment	50	1452	41.66
LA10	DALA 5208	*Acaulospora*	globose , hyaline 81 x 86 µ	50	4917	21.66
LA11	DALA 5211	*Acaulospora*	globose , hyaline , pale green , pitted-spore surface 149 x 156 µ	50	1870	45
LA12	DALA 5212	*Glomus*	globose , hyaline , straight – recurved, branched attachment 80.5 x 88 µ	20	1287	26.66
LA16	DALA 5215	*Gigaspora*	globose , white , pink 235 µ	100	3751	30
LA7	DALA 5219	*Acaulospora*	globose , hyaline , pale green , pitted-spore surface 112 x 120 µ	10	114	46.66
NA10	DANA 5220	*Acaulospora*	globose , reddish , yellow brown, funnel hypha 160 x 165 µ	22	1749	85
LA19	DALA 5221	*Glomus*	globose , yellow , brown , straight branched attachment 313 x 325 µ	20	198	16.66
LA20	DALA 5224	*Acaulospora*	globose , hyaline 100 µ	50	2178	23.33
LA4	DALA 5230	*Glomus*	globose , subglobose , gray green , straight attachment 115 x 121.5 µ	20	2002	25
LA16	DALA 5231	*Glomus*	globose , ovoid , brownish-yellow,	50	902	40

			funnel shape spore 220 x 235 µ			
NA11	DANA 5234	*Glomus*	globose , subglobose , ellipsoil , greenish , yellow brown , straight recurved attachment 106 x 112 µ	10	352	13.33

Table 2.1 Average of height fresh and dry weight of pod, stem and leaves of soybean growin g

treatment	height (cm.)	fresh wt. pod (gm. / pl.)	dry wt. pod (gm. / pl.)	fresh wt. stem (gm.)	dry wt. stem (gm.)	fresh wt. leaves (gm. / pl.)	dry wt. leaves (gm. / pl.)
DAPR 5001	140.64 ab	11.70 cd	4.51 cd	4.51 cde	1.38 def	3.27 f	0.96 e
DANA 5011	151.88 ab	31.20 a	13.38 a	8.37 a	2.83 a	9.49 cd	2.82 c
DAPJ 5026	144.64 ab	18.23 bc	7.58 bc	7.05 ab	2.24 abc	3.23 f	1.08 e
DACB 5169	159.58 a	18.59 bc	6.03 bcd	5.59 bcd	1.42 c-f	15.48 a	2.82 a
DAPC 5170	136.88 ab	8.68 d	2.76 d	3.37 e	0.86 f	3.65 f	0.92 e
DACB 5176	163.96 a	12.02 cd	4.86 cd	7.86 ab	2.35 ab	14.42 ab	3.85 b
DALA 5203	127.71 ab	22.29 b	9.20 b	6.39 abc	2.02 bcd	12.38 bc	2.25 cd
DANA 5220	111.67 ab	13.47 cd	4.77 cd	5.66 bcd	1.64 b-f	4.96 ef	1.38 de
DACM 5226	144.17 ab	23.84 b	10.19 ab	6.14 bcd	1.99 bcd	10.09 cd	2.62 c
DANA 5229	132.08 ab	8.96 d	3.15 cd	5.80 bcd	1.76 b-e	7.42 de	1.13 e
Control (ไม่ใส่เชื้อ)	92.92 b	10.45 cd	3.20 cd	3.94 de	0.97 ef	4.38 f	1.23 e
% CV	36.5	38.2	53.1	29.1	35.5	29.9	37.0

Table 2.2 Average of fresh and dry root, amount of spores and root infection of soybean growin g

treatment	fresh wt. root (gm. / pl.)	dry wt. root (gm. / pl.)	no. spore /100 g soil	root infection (%)
DAPR 5001	4.77 bc	0.55 d	264 d	5.45 f
DANA 5011	7.03 bc	0.87 bc	7232 b	75.63 bc
DAPJ 5026	4.26 c	0.48 d	213 d	29.32 e
DACB 5169	7.97 b	0.89 bc	2689 c	68.93 cd
DAPC 5170	5.23 bc	0.53 d	0 e	0 e
DACB 5176	12.42 a	1.21 a	16511 a	87.54 a
DALA 5203	11.08 a	1.02 ab	416 d	83.53 ab
DANA 5220	6.39 bc	0.58 d	46 d	12.30 f
DACM 5226	6.41 bc	0.72 cd	2939 c	58.91 d
DANA 5229	6.95 bc	0.67 cd	1354 d	72.21 c
Control (ไม่ใส่เชื้อ)	5.35 bc	0.50 d	0 e	0 e
%cv	37.5	26.1	29.0	14.3

* Common letters are not significantly difference in statistics at 5 % by DMRT

Table 3.1 Average of height bush fresh and dry weight of stem and leaves of *Sesbania gradiflora*

treatment	height (cm.)	bush (cm)	fresh wt. stem (gm.)	dry wt. stem (gm.)	fresh wt. leaves (gm. / pl.)	dry wt. leaves (gm. / pl.)
DAPR 5001	23.9 ab	36.70 a	5.01 ab	0.78 a	12.63 a	2.16 a
DANA 5011	20.3 bcd	32.80 ab	2.68 d	0.41 c	6.00 bc	1.33 bc
DAPJ 5026	25.2 a	33.40 ab	5.13 a	0.74 a	9.60 b	1.65 b
DACB 5169	20.1 bcd	32.40 bc	2.64 d	0.41 c	7.45 c	1.28 cd
DAPC 5170	20.7 bcd	30.50 bcd	4.04 bc	0.64 ab	6.63 cd	1.20 cd
DACB 5176	19.9 bcd	30.70 bcd	3.70 c	0.56 b	5.92 cd	0.98 cde
DALA 5203	21.5 abc	30.20 bcd	4.53 abc	0.70 ab	6.25 cd	1.01 cde
DANA 5220	17.8 cd	30.00 bcd	1.41 ef	0.24 de	4.96 de	0.91 de
DACM 5226	18.0 cd	28.30 cd	2.07 de	0.29 cd	3.77 ef	0.72 ef
DANA 5229	16.4 d	27.30 d	0.61 fg	0.10 e	2.15 f	0.52 f
Control (ไม่ใส่เชื้อ)	12.2 e	14.80 e	0.38 g	0.10 e	0.11 g	0.07 g
% CV	16.2	10.2	27.4	27.3	25.3	25.6

Table 3.2 Average of fresh and dry root, amount of spores and root infection of *Sesbania gradiflora*

treatment	fresh wt. root (gm. / pl.)	dry wt. root (gm. / pl.)	no. spore /100 g soil	root infection (%)
DAPR 5001	7.23 a	0.74 a	516.60 a	35.33 a*
DANA 5011	3.74 de	0.37 bc	7.60 c	2.66 c
DAPJ 5026	5.72 b	0.65 a	71.00 b	17.33 b
DACB 5169	4.12 cd	0.43 b	51.60 bc	7.46 c
DAPC 5170	7.18 a	0.74 a	5.20 c	2.00 c
DACB 5176	5.37 bc	0.59 a	22.20 bc	16.13 b
DALA 5203	6.04 ab	0.69 a	69.80 b	18.33 b
DANA 5220	2.59 ef	0.22 cd	7.80 c	2.00 c
DACM 5226	2.35 f	0.23 cd	6.80 c	1.88 c
DANA 5229	0.53 g	0.07 d	12.00 bc	8.92 c
Control (ไม่ใส่เชื้อ)	0.56 g	0.07 d	4.00 c	1.00 c
%cv	27	29.8	59.2	54.8

* Common letters are not significantly difference in statistics at 5 % by DMRT

Figure 1 Amount of collected VAM spores in different soil pH collect from area growing leguminous plant

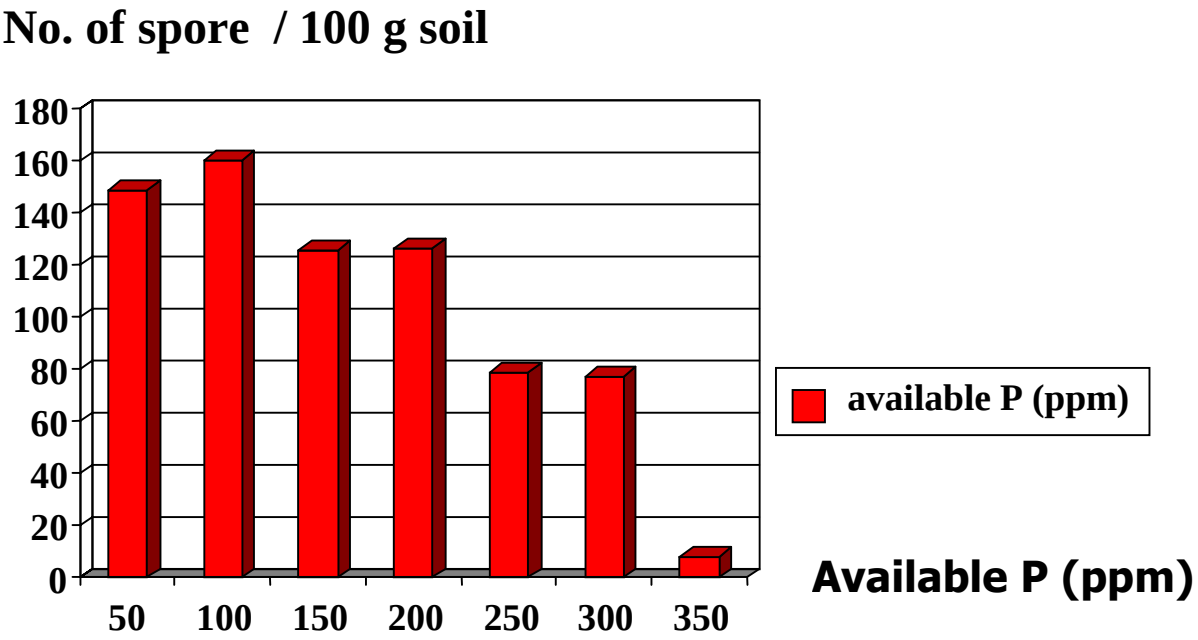

Figure 2 Amount of collected VAM spores in different concentration of available phosphorus in soils growing leguminous plant