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EFFECTIVENESS OF *Acaulospora tuberculata* AND *Gigaspora margarita* SYMBIOSIS IN THE NURSERY OF OIL PALM UNDER FIELD CONDITIONS

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ABSTRAK

Percobaan dilakukan untuk menguji keefektifan Acaulospora tuberculata *dan* Gigaspora margarita *pada pembibitan kelapa sawit pada sistem pembibitan di lapang. Percobaan dilakukan menggunakan tanah Ultisol. Kecambah kelapa sawit digunakan sebagai bahan tanam. Inokulum mikoriza arbuskula dihasilkan dari kultur pot. Percobaan dilakukan menggunakan rancangan acak lengkap faktorial 3 x 2 dan setiap perlakuan diulang 10 kali. Faktor pertama adalah inokulasi (kontrol), inokulasi dengan* A. tuberculata *dan* G. margarita *dan faktor ke dua adalah sterilisasi media yaitu media steril dan tidak steril. Media tanam disterilisasi menggunakan oven selama 8 jam pada suhu 105°C sebanyak tiga kali dengan selang satu malam. Hasil percobaan menunjukkan bahwa* A. tuberculata *dan* G. margarita *efektif meningkatkan pertumbuhan dan serapan P bibit kelapa sawit. Inokulasi* A. tuberculata *menghasilkan pertumbuhan dan serapan P lebih tinggi dibandingkan dengan* G. margarita. *Laju pertumbuhan yang disebabkan inokulasi mikoriza lebih tinggi pada inokulasi* A. tuberculata *dibandingkan dengan inokulasi* G. margarita. *Inokulasi* A. tuberculata *pada tahap pre nurseri (PN) dalam kombinasinya dengan pemupukan kimia 25% dosis standar menghasilkan pertumbuhan dan serapan P masing-masing 2,5 kali dan 3,6 kali lebih tinggi dibandingkan dengan tanaman yang tidak diinokulasi.*

kata kunci: *bibit kelapa sawit, cendawan mikoriza arbuskula, keefektifan, kejaguran, kondisi lapang*

ABSTRACT

The experiment was conducted to asses effectiveness of the Acaulospora tuberculata *and* Gigaspora margarita *in the nursery of oil palm under field conditions. The experiment was conducted using Ultisol soil as medium. Germinated oil palm was used as plant material. Arbuscular mycorrhizae (AM) fungal inoculum was produced in pot culture. The experiment was done in factorial completely randomized design 3 x 2 in ten replicates. First factor consisted of no inoculation (control), inoculated with A. tuberculata and inoculated with* G. margarita. *Second factor consisted of sterilized and unsterilized media. Soil media was sterilized using oven for 8 hours at 105°C in three times of intermitted overnight. The result showed that* A. tuberculata *and* G. margarita

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were effective to increase the growth and P uptake of oil palm seedlings. Comparing the two AMF used, A. tuberculata *inoculation resulted higher plant growth and P uptake compared to that of* G. margarita. *The mycorrhizal growth rate (MGR) was higher in* A. tuberculata *compared to* G. Margarita. *Inoculation of* A. Tuberculata in *oil palm seedling in the pre nursery stage (PN) in combination with 25% fertilizer addition, yielded 2.5 times higher growth and 3.6 times P uptake respectively compared to uninoculated seedlings.*

Key words: *oil palm seedling - arbuscular mycorrhizal fungi-effectiveness vigor - field conditions*

INTRODUCTION

Oil palm (*Elaeis guineensis*, Jacq) is mycotropic plant species and naturally oil palm associates with AM fungi (13). Advance study showed that inoculation of oil palm in glasshouse experiment with AM fungi enhance fertilizer efficiency (2, 15), increase plant root system (17), nutrient uptake (14), and increase plant survival derived from in vitro culture (12). But, generally the research was conducted using sterilized soil. In the field, oil palm nursery was done using unsterilized soil. Sterilization was not economic and could kill beneficial soil microbes including indigenous AM fungi. Some researches showed that interactions between AM fungi with other microbes increase the benefit of AM fungi symbiosis. However, AM fungi inoculant have to be effective in unsterilized soil.

In optimum condition, introduced AM fungi could compete with indigenous AM fungi. This research was conducted to study the effectiveness of *Acaulospora tuberculata* and *Gigaspora margarita* in enhancing plant growth and P uptake of oil palm seedling under field condition. *A. tuberculata* and *G. margarita* have been reported effective to promote the growth of oil palm seedlings (15).

MATERIALS AND METHOD

Biological materials and soil

The research was done in 60 x 40 cm polybag containing 15 kgs Ultisol soil from Cikopomayak, Lebak, West Java. Chemical properties of soil is presented in Table 1. Germinated oil palm dura x pisifera (D x P) was obtained from Indonesian Oil Palm Research Institute, Medan, North Sumatera, while AM fungi inoculum resulted from open pot culture propagated using *Pueraria phaseoloides*

Table 1. Chemical properties of Cikopomayak acid soil used as media

Soil	N(%)	Corg	P_2O_5 (%)	CaO (%)	K_2O (%)	MgO (%)	Exch. Al (me 100 g^{-1})
Unsterilized	0.27 m	1.29 l	0.01 vl	0.069	0.01 vl	0.047	15.52
Sterilized	0.098vl	1.42 l	0.01 vl	0.052	0.009 vl	0.041	14.9

Note: m: moderate, l: low; vl: very low

for *A. tuberculata* and maize for *G. margarita*. The *A. tuberculata* isolate was obtained from collection of Indonesian Biotech-nology Research Institute for Estate Crops (IBRIEC) isolated from oil palm rhizosphere while *G. margarita* obtained from collection of Indonesian Research Centre for Cocoa and Coffee that was isolated from soybean rhizosphere.

Growth and harvest conditions

Acid soil was sterilized using oven for 8 hours in 105°C for three times intermitted. Inoculation was conducted in the media when planting by mixing inoculum with planting medium. Inoculum was mixed of propagule containing spore, infected root, and external hypha. The inoculum dosage was calculated based on the optimum oil palm dry weight for each fungal species. Therefore the inoculum dosage for *A. tuberculata* and *G. margarita* was 36,42% and 39,98% (w/w) respectively, while the dosage of fertilizer was given in optimum rate of 100%, 25%, and 26% each for controle, *A. tuberculata*, and *G. margarita* treatment respectively (16).

During incubation in glass house, plant was watered using tap water. Plant height was measured every month, while other parameters such as plant growth (dry weight), relative water content, shoot root ratio, mycorrhizal growth response (% MGR), sterilization growth response (%SGR), microbe total number, AM fungal colonization (6), and root uptake were observed 6 months after planting. Plant height was measured from stem base up to the highest leaf, plant dry weight was observed after drying in oven 500C, relative water content analysis was done by subscribing the weight of plant before and after drying, total microbe was analysed by plating sample in nutrient agar, while AM fungi colonization was analyzed after root staining (6) with modification in period of cytoplasm clearing (18).

The percentage response of oil palm seedling to mycorrhizal colonization in terms of total plant dry weight (mycorrhizal growth response, % MGR) in *A. tuberculata* and *G. margarita* was calculated using the following equation:

$$\% \text{ MGR} = \frac{\text{dry weight (inoculated plant) dry weight (uninoculated plant) x 100\%}}{\text{mean dry weight (uninoculated plant)}}$$

The percentage response in growth of oil palm seedling to sterilization (sterilization growth response, % SGR) for *A. Tuberculata* and *G. margarita* inoculation was calculated as :

$$\% \text{ SGR} = \frac{\text{plant dry weight (sterilized) plant dry weight (unsterilized) x 100\%}}{\text{dry weight (unsterilized)}}$$

Experimental design

The research was done in factorial completely randomized design 3 x 2 in 10 replicates for each treatment. Six treatments assed are combinations of first factors consisted of without inoculation (M0), inoculated with *A. tuberculata* (M1), and inoculated with *G. Margarita* (M2)) and second factor consisted of sterilization (S0) and without sterilization (S1) medium.

RESULTS AND DISCUSSION

Growth of oil palm seedlings

Arbuscular mycorrizae fungi inoculation increased shoot and root growth of oil palm seedling both in unsterilized and sterilized medium (Figure 1). Plant height of uninoculated seedlings, grown on sterile medium (M0S1) was very low (Figure 2). Better plant height was observed in uninoculated seedling grown on unsterile

Figure 1. Oil palm seedling planted in unsterilized (S0) media (left) and sterilized (S1) media (right). M0: uninoculated; M1; inoculated with *A. tuberculata*; M2: inoculated with *G. margarita*

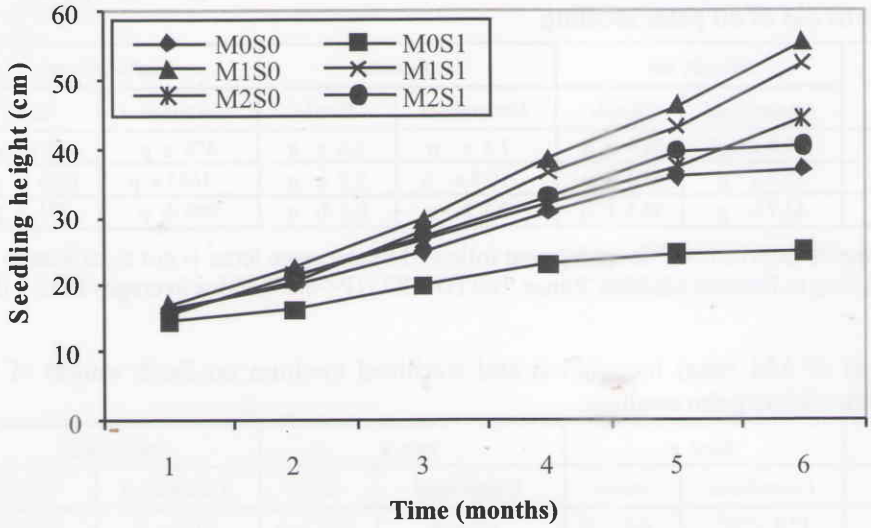

Figure 2. Effect of AM fungi inoculation and medium sterilization on oil palm seedling height six months old. M0: uninoculated; M1: *A. tuberculata*; M2: *G. margarita;* S0: unsterilized media; S1: sterilized media.

medium (M0S0). Inoculation with *A. tuberculata* and *G. margarita* has significantly increased plant height both on sterile and unsterile media. Moreover, *A. tuberculata* inoculation gave higher plant height growth compared to *G. margarita* inoculation. Lubis (7) showed that height of six-month old oil palm seedling in nursery was 40 cm. This height reached in this research when the seedlings were incubated for 5 months especially in *A. tuberculata* inoculation. However, seedling height of inoculated either with *A. tuberculata* or *G. margarita* were higher compare to standard height of seedling height standard. This result showed that AM fungi inoculation could reduce period of oil palm in nursery.

Analysis of variance showed that there were significantly interactions between AM fungi inoculation and sterilization medium to the seedling growth parameters (Table 2 and 3). *Acaulospora tuberculata* inoculation as well as *G. margarita* inoculation increased plant growth significantly. It was higher compared to uninoculated seedlings. In addition, *A. tuberculata* inoculation resulted plant growth better compared to *G. margarita* inoculation. The higher growth of inoculated seedling may be resulted from the better leaf growth of inoculated seedling as shown by leaf wide and number (Table 2). The enhancement of leaf wide and number in *A. tuberculata* inoculated seedling gave a change for seedlings to increase the photosynthase activition that resulted higher production of photo-syntates and in turn the plant grow faster. Nemec and Vu (8) showed that AM fungi

Table 2. Effect of AM fungi inoculation and sterilization medium on growth of six months old of oil palm seedling

AMF*Inoc. AMF*	*Height, cm*		*Leaf number*		*Leaf wide, cm²*	
	Unsterilized	*Sterile*	*Unsterilized*	*Sterile*	*Unsterilized*	*Sterile*
Uninoculated	36.9 c[1] p[2]	24.9 c q	7.3 c p	5.6 c q	476 c p	199 c q
A. tuberculata	55.4 a p	52.4 a p	10.8 a p	9.9 a p	1633 a p	1325 a q
G. margarita	44.7 b p	39.3 b q	9.3 b p	8.2 b q	889 b p	741 b p

[1] Figure in same column or row [2] in each group followed by the same letter is not significantly different according to Duncan Multilpe Range Test (DMRT) (P< 0.05).Value averages from 3 data

Table 3. Effect of AM fungi inoculation and sterilized medium on fresh weight of six months old oil palm seedling.

Effect	shoot, g		root, g		seedling, g	
AMF	Unsterilized	sterile	Unsterilized	sterile	Unsterilized	sterile
Uninoculated	17.3 c[1] p[2]	6.6 c p	7.0 c p	2.7 c p	24.3 c p	9.3 c p
A. tuberculata	70.6 a p	56.8 a q	26.4 a p	23.2 a p	97.1 a p	80.0 a q
G. margarita	37.8 b p	31.3 b p	18.0 b p	13.8 b p	55.9 b p	45.1 b p

[1] 1) Figure in same column or row 2) in each group followed by the same letter is not significantly different acording to Duncan Multilpe Range Test (DMRT) (P< 0.05).

inoculation increase CO2 fixation 67% higher and content of chlorophyll 28.

Fresh weight (Table 3) observation showed that there was similar tendency with plant dry weight observation (Table 4) namely AM fungi inoculation either *A. tuberculata* or *G. margarita* enhance oil palm growth. Moreover, the growth of oil palm seedling (fresh and dry weight) inoculated with *A. tuberculata* higher compared to those of inoculated with *G. margarita*. Sterilization significantly reduce the fresh weight of shoot and plant inoculated with *A. tuberculata*. Based on the dry weight parameter, sterilization significantly reduced the dry weight of uninoculated palm and have inoculated with *A. tuberculata*, but in *G. margarita* inoculation, sterilization did not affect the dry weight of seedling.

Root observation showed that root inoculated seedling especially with *A. tuberculata* was better compared to those of uninoculated or with *G. margarita* The better rooting system may increase nutrient uptake nutrient especially for immobile nutrient. In addition, the higher root growth in inoculated seedling may due to the role of AM fungi symbiosis in enhancing resistancy of oil palm seedling to aluminium toxicities. Similar result has been reported by Cumming & Ning (5) in their research of AM fungi symbiosis in *A. virginicus*, L.

The higher relative water content of inoculated oil palm seedling showed that AM fungi inoculation increased water uptake of seedlings (Table 5). Relative

Table 4. Effect of AM fungi inoculation and sterilized medium on dry weight of six months old oil palm seedling.

Effect	shoot, g		root, g		seedling, g	
AMF	Unsterilized	sterile	Unsterilized	sterile	Unsterilized	sterile
Uninoculated	7.2 c[1] p[2]	4.3 c q	2.4 c p	1.4 c q	9 ,6 c p	5.6 c q
A. tuberculata	18.9 a p	15.2 a q	5.3 a p	4.3 a q	24.2 a p	19.5 a q
G. margarita	11.3 b p	9.5 b p	3.5 b p	3.1 b p	14.8 b p	12.6 b p

Table 5. Effect of AM fungi inoculation and sterilization medium on relative water content of six months old oil palm seedling.

Effect	shoot, %		root, %		seedling, %	
AMF	Unsterilized	sterile	Unsterilized	sterile	Unsterilized	sterile
Uninoculated	56.7 b[1] p[2]	31.0 b q	64.1 b p	55.9 b q	59.2 b p	41.7 b q
A. tuberculata	73.0 a p	72.8 a p	79.2 a p	79.9 a p	74.8 a p	75.1 a p
G. margarita	69.8 a p	68.1 a p	79.7 a p	75.3 a p	73.1 a p	71.0 a p

Table 6. Mycorrhizal growth rate (MGR) as affected by AM fungal inoculation.

AM fungi species	unsterilized			sterile		
	uninoc.	inoc.	MGR (%)	uninoc.	inoc.	MGR (%)
A. tuberculata	9.64	24.20	151.00	6.08	19.8	220.39
G. margarita	9.64	14.83	53.84	6.08	12.63	107.70

water content of oil palm seedling inoculated with *A. tuberculata* was not significantly different compared to those inoculated with *G. margarita*. Sterilization only affects the relative water content of shoot and root of uninoculated seedling but sterilization did not affect relative water content of seedlings in inoculated seedling. The higher water uptake was caused by better rooting system in addition to the existence of external hyphae of AM fungi. Observation of root fresh weight showed that inoculation resulted higher root fresh weight especially *A. tuberculata* inoculation (Table 3). The ability of AM fungi in symbiosis with plant in enhancing water uptake has been reported by O'Keefe and Sylvia (9). Their research showed that plant inoculated with AM fungi in dry condition could increase water uptake. The mechanism may be as a result of smaller size of external hyphae compared to root and wider coverage area for water uptake.

Calculation of the percentage response of plant to *A. tuberculata* colonization in term of total plant dry weight (MGR) showed that medium sterilization produced higher MGR compared to unstrile medium (Table 6). Similar result was observed in *G. margarita*. Calculation of mycorrhizal

Table 7. Sterilized growth rate (SGR) as affected by sterilization medium

AM fungi species	Uninoculated			Inculation of AM fungi		
	Unsterilized	sterile	SGR (%)	Unsterilized	sterile	SGR (%)
A. tuberculata	9.64	6.08	-36.90	24.20	19.48	-19.50
G. margarita	9.64	6.08	-36.90	14.83	12.63	-14.80

Table 8. Effect of AM fungi inoculation and sterilization medium on shoot nutrient concentration of six months old oil palm seedling.

AMF inoc.	N (%)		P (%)		K (%)	
	Unsterilized	Sterile	Unsterilized	Sterile	Unsterilized	Sterile
Uninoc.	1.96 a[1] p[2]	2.16 a p	0.18 b p	0.15 b p	2.03 a p	1.96 a p
A. tuberculata	2.02 a p	2.14 a p	0.26 a p	0.24 a p	1.92 a p	2.06 a p
G. margarita	1.94 a p	1.90 b p	0.25 a p	0.18 b q	194 a p	1.94 a p

[1]Figure in same column or row[2] in each group followed by the same letter is not significantly different acording to Duncan Multilpe Range Test (DMRT) ($P<0.05$).

growth rate (MGR) showed that AM fungi inoculation produced better growth response. However, MGR of seedling inoculated with *A. tuberculata* was higher compared to *G. margarita*. The higher of MGR in sterile condition showed that higher role of AM fungi for plant growing in stress condition compared to unstressed condition.

Percentage responses in plant growth to sterilization (SGR) showed that sterilization reduced seedling growth either inoculated seedling or uninoculated one (Tabel 7). Higher temperature become limiting in AM fungal symbiosis since sterilization inhibited spore germination, hyphae growth, AM fungal colonization and spore formation. Higher temperature could affect spore viability that in turns resulted death spore. Generally temperature above 40°C could killed AMF however Glomus intraradices still alive. In general, higher temperature affects biological, chemical, physical of soil properties. In this research, SGR in inoculated seedling was higher compared to uninoculated seedling. Results from this research showed that AMF inoculation suppressed negative affect of medium sterilization and *G. margarita* inoculation has higher ability to suppresses the negative effect of medium sterilization compared to *A. tuberculata.*

Nutrient content and uptake of oil palm seedling

Chemical analysis showed that there were no significant differences between chemical properties of sterilized medium and unsterilized medium except for N content. Sterilized soil had N content lower as compared to unsterilized soil. Since the sterilization of the soil in this experiment

Table 9. Effect of AM fungi inoculation and sterilization medium on shoot nutrient uptake of six months old oil palm seedling.

AMF Inoc.	N (mg)		P (mg)		K (mg)	
	Unsterilized	Sterile	Unsterilized	Sterile	Unsterilized	Sterile
Uninoc.	157.9 c[1] p[2]	100.9 c p	14.9 c p	7.0 c p	162.6 c p	91.4 c q
A. tuberculata	416.9 a p	363.8 a p	53.9 a p	41.5 a q	395.9 a p	351.4 a p
G. margarita	248.5 b p	234.1 b p	31.3 b p	23.6 b p	248.9 b p	240.9 b p

[1] Figure in same column or row [2] in each group followed by the same letter is not significantly different according to Duncan Multilpe Range Test (DMRT) (P< 0..05).

Table 10. Vigor of six months old of oil palm seedling in each treatment.

Treatment	Height ± SD	Coefficient variation (cv)
M0S0	36.9 ± 4.3	11.6
M0S1	24.9 ± 5.3	21.4
M1S0	55.4 ± 4.8	8.6
M1S1	52.4 ± 6.5	12.5
M2S0	44.7 ± 4.4	9.9
M2S1	40.4 ± 6.8	17.0

Note: M0: uninoculated; M1: A. tuberculata; M2: G. margarita; S0: unsterilized; S1: sterilized medium

was using hot steam water (autoclave), it was possible that the higher temperature in sterilization process increase the N vopouration that in turn reducing the N content of soil as planting media. Seedling growth in unsterilized medium was better compared to those in sterilized medium especially in *A. tuberculata* inoculated seedlings (Table 2, 3, & 4). It was apparent that AM fungi inoculation especially *A. tuberculata* could solve the smaller content of N in unsterilized soil by increasing the N uptake compared to *G. margarita* inoculation. The N content in oil palm seedlings inoculated with *G. margarita* significantly was lower than those of *A. tuberculata* inoculated seedling. The ability of mycorrhizal plant in enhancing N uptake has been previously reported by Cruz (4).

Phosphorus content in shoot of seedlings inoculated with *A. tuberculata* and *G. margarita* significantly was higher compared to P content in shoot of uninoculated seedling, but in sterilized medium only P concentration of shoot of *A. tuberculata* inoculated seedling was significantly higher compared to unino-

culated seedlings. The higher nutrient concentration of mycorrhizal seedling has been reported by Bolan (3). Smith dan Gianinnazzi Pearson (11) showed that the higher nutrient content was exclusive accumulation process. Sterilization significantly reduces P shoot content in *G. margarita* inoculated seedling while potasium content of seedlings was not affected by inoculation and sterilization of media.

Arbuscular mycorrhizal fungi inoculation increased N, P, and K uptake of seedlings and *A. tuberculata* inoculation produced higher nutrient uptake compared to those seedlings inoculated with *G. margarita* (Tabel 9). This result showed that even AM fungi has been known increase P uptake, but in higher P uptake, it will also change the nutrient balance in seedlings and other nutrient uptake such as N, and K. Other reason that in this research condition, P was a constraint to plant growth, increasing P uptake will reduce the limiting factor and new nutrient balance will take over.

Sterilization of medium only affected on P, and K uptake. In uninoculated seedlings, sterilization process resulted lower K uptake significantly compared to nutrient uptake of seedling growing in unsterile medium. Similar result was also found in *A. tuberculata* inoculated seedling in term of P uptake.

Arbuscular mycorrhizal fungi colonization revealed that there were 18% AM fungi colonization in root of oil palm seedlings growing in unsterilized medium. This result showed that there was indigenous AM fungi in unsterilized soil. *A. tuberculata* and *G. margarita* colonization in oil palm grown in sterilized soil were 58% and 47%, while colonization of *A. tuberculata* and *G. margarita* in unsterilized soil were 35% and 30% respectively. These results showed that there was indigenous AM fungi soil used in this experiment that also infected oil palm root seedling and it may be possible that this indigenous AM fungi inhibited *A. tuberculata* and *G. margarita* infection. In addition, soil observation of unsterile soil found at least three species of phosphate solubilizing bacteria. (Figure 3). The phosphate solubilizing bacteria have been known able to solubilize inorganic P that was unavailable through organic acid production. However, interaction of indigenous AM fungi, phosphate solubilizing bacteria resulted plant growth and nutrient uptake especially P higher compared to *A. tuberculata* inoculation in sterile soil. It was suggested that interactions between *A. tuberculata*, indigenous AM fungi and indigenous phosphate solubilizing bacteria was synergistic to promote the growth of the seedlings.

Moreover, AM fungi inoculation increased fertilizer efficiency. In *A. tuberculata* inoculation the fertilizer dose was 25%, in *G. margarita* 26% while uninoculated seedling the fertilizer dose was 100%. Growth (Table 4) and nutrient uptake (Table 9) of oil palm in *A. tuberculata* inoculation 2.5 times and 3.5 times uninoculated oil palm seedling while *G. margarita* inoculation was 1.5 times and 2 times uninoculated seedling respectively. This result showed that *A. tuberculata* and *G. margarita* were effective to increase the growth and P fertilizer efficiency of oil palm seedling. In this research it was showed that there was different responses of each AM fungi species in increasing

Figure 3. Colony of phosphate solubilizing bacteria isolated from unsterilized soil inoculated with *A. tuberculata*

growth and nutrient uptake of oil palm seedlings. *Acaulospora tuberculata* more able to increase plant growth as compared to *G. margarita*. The ability of *A. tuberculata* to adapt and tolerance to soil condition used in this research was important factor resulting different growth responses of oil palm seedlings. *Acaulospora tuberculata* was isolated from oil palm field (13) and some research results showed that *A. tuberculata* have wider natural distribution and compatibility including in oil palm, and tropical forest.

Vigor of oil palm seedling

Calculation of coefficient variation (cv) in term of height of plant showed that seedling growing in unsterilized soil more vigorous compared to those growing in sterilized medium (Table 10). In addition, the smallest cv reach in seedling inoculated with *A. tuberculata* grow in unsterile medium. This result showed that *A. tuberculata* inoculation in unsterilized medium resulted more vigourus seedling compared to those of uninoculated seedling. In addition, it was showed that AM fungi inoculation resulted more vigourus oil palm seedlings compared to uninoculated seedlings. Among examined treatment *A. tuberculata* inoculation in unsterilized soil produced more vigorous seedlings growth compared to other treatments. Aikio (1) showed that AM fungi inoculation could buffer nutrient fluctuation. Seedling vigour has positive affect in easier pesticide, and fertilizer applications as well as harvesting.

CONCLUSIONS AND SUGGESTION

Arbuscular mycorrhizal fungi inoculation i.e *A. tuberculata* and *G. margarita* increased the growth and N,P, K uptake of oil palm seedlings both in sterilized and unsterilized acid soil media. Moreover, AM fungi inoculation increase fertilizer efficiency and the vigor of oil palm seedling. Inoculation of *A. tuberculata* resulted better oil palm seedling growth and nutrient uptake compared to those inoculated with *G. Margarita.*

In the future, this suggested to further study the effect of AM fungi symbiosis in oil palm after planting in the field.

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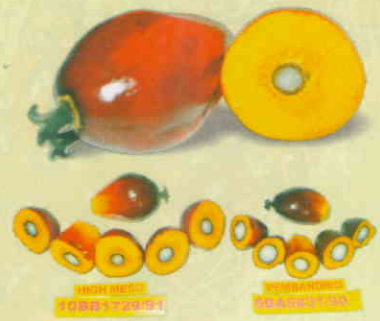
Bahan Tanaman Varietas Baru

- Pusat Penelitian Kelapa Sawit (PPKS) sebagai produsen benih unggul kelapa sawit pertama di Indonesia telah mendistribusikan lebih dari 740 juta kecambah kelapa sawit, yang setara dengan 3,7 juta ha.
- Pada tahun 2007, PPKS telah melepas dua varietas kelapa sawit baru: **DxP PPKS 540** dan **DxP PPKS 718**.

VARIETAS BARU

DxP PPKS 540



- Hasil seleksi siklus kedua program RRS (*recurrent reciprocal selection)* yang dimulai tahun 1986.
- Memiliki keunggulan dalam persentase daging buah (mesokarp) yang sangat tinggi, hingga 89%.
- Tingkat rendemen minyak laboratorium mencapai 32,3%.
- Tingkat produksi CPO 8,1 ton/ha/tahun.

DxP PPKS 718

- Memiliki keunggulan dalam rerata bobot tandan (RBT) yang lebih tinggi.
- Nilai RBT yang tinggi ini telah tampak saat awal panen dan perbedaannya mencapai 9 kg pada saat tanaman berumur 9 tahun dibandingkan dengan varietas lainnya.
- Sesuai untuk dikembangkan di daerah pertanaman yang ketersediaan tenaga pemanennya kurang mencukupi.
- Melalui penggunaan varietas ini pekebun hanya membutuhkan 75% jumlah tenaga pemanen.

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