IJHAF_2020-4-5_Dulur-Wy-Nihla-Kus_Growth-n-yield-of-soybean.pdf

by

Open Access

International journal of Horticulture, Agriculture and Food science(IJHAF)
Vol-4, Issue-5, Sep-Oct, 2020
https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

Growth and Yield of Soybean Direct-seeded following Conventional and Aerobic Rice Intercropped with Peanut and Amended with Organic wastes

Ni Wayan Dwiani Dulur[2], Wayan Wangiyana[1*], Nihla Farida[1], I.G.M. Kusnarta[2]

[1]Department of Agronomy, Faculty of Agriculture, University of Mataram, Mataram, NTB, Indonesia
[2]Department of Soil Sciences, Faculty of Agriculture, University of Mataram, Mataram, NTB, Indonesia
[*]Corresponding author email: w.wangiyana@unram.ac.id

***Abstract*— *Previous studies reported that growing soybean in a dry season following conventional (flooded) rice resulted in lower grain yield compared with following rice cultivated using SRI (system of rice intensification) technique unless it was fertilized with mycorrhiza biofertilizer. This study aimed to examine residual effects of different rice cultivation techniques and organic waste application to the preceding red rice crops on growth and yield components of soybean direct-seeded without tillage following harvest of the preceding rice crop. The experiment on the red rice was arranged according to Split Plot design with three blocks and two treatment factors applied the rice crop, namely rice cultivation techniques as the main plots (T1= conventional, T2= aerobic rice on permanent raised-beds (ARR) without intercropping, T3= ARR + peanut, T4= ARR + peanut + rice straw mulch) and organic wastes applied to the red rice as the subplots (L0= without organic waste, L1= with rice husks, L2= with rice husk ash, L3= with rice husk ash and cattle manure). Results indicated that growth and yield variables of soybean direct-seeded following the red rice crop that showed significant residual effects of both treatment factors applied to the preceding red rice crop were leaf number at 8 weeks after planting, harvest index, grain number and grain yield per clump. Grain yield was highest (18.43 g/clump or 3.69 ton/ha) on soybean plants direct-seeded following aerobic rice grown on permanent raised-bed intercropped with peanut thin covered with rice straw mulch (T4) and amended with rice husk ash and cattle manure (L3), and lowest (8.54 g/clump or 1.71 ton/ha) on soybean plants direct-seeded following conventional rice (T1) without application of organic wastes (L0).*

Keywords*— *Peanuts, red rice, intercropping, aerobic irrigation systems, row patterns.

I. INTRODUCTION

Soybean [*Glycine max* (L) Merr.] seed is a major source of protein, oil, carbohydrates, isoflavones, and minerals for human and animal nutrition. Worldwide, about one-third of the world's edible oils and two-thirds of protein meal are derived from soybean seed (Bellaloui *et al*., 2011). In Indonesia, soybean is one of the food crops that are needed by the population, which is the third most important food crop after rice and maize. It is because soybean is a cheap source of protein, fat, vitamins and minerals, and soybean is easy to grow in various parts of Indonesia. The need for soybeans continues to increase in line with the increasing demand for animal feed and processed food using soybean as the material such as tofu, "tempe", soy sauce, soy milk, "tauco" and soy snacks (Suryana, 2008).

In addition, consumption of soybeans by the Indonesian people will continue to increase every year due to several factors such as increasing population, per capita income, and awareness of the community on food nutrition

International journal of Horticulture, Agriculture and Food science(IJHAF)
Vol-4, Issue-5, Sep-Oct, 2020
https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

(Aldillah, 2015). The domestic production of soybean has not been able to meet the increasing domestic demand for soybeans, so that Indonesia continues to import soybeans (Aimon and Satrianto, 2014; Aldillah, 2015).

In Indonesia, soybeans are generally grown in irrigated or rainfed rice fields in the dry season after rice harvest, without soil tillage. In addition, farmers generally do not apply any fertilizer to the soybean plants, so that soybean productivity that can be achieved by farmers is generally still low (Subandi *et al*., 2013). The results of research on full fertilization and soil tillage carried out on soybean following paddy rice in East and South Lombok also showed no difference in soybean productivity between fully fertilized soybean plants and those without fertilization, and grain yields were low in all treatments, with the highest averages of 1.29 ton/ha in Sengkol and 1.48 ton/ha in Keruak (Adisarwanto *et al*., 1992).

The results of experiments in vertisol soil showed that soybean plants grown following paddy rice were very responsive to inoculation with Arbuscular Mycorrhizal Fungi (AMF), especially following rice crop grown under conventional (flooded) systems (Wangiyana and Farida, 2019; Wangiyana *et al*., 2019). Without application of biofertilizers containing AMF, soybean plants grown following conventional paddy rice resulted in very low productivity, while those following rice grown under SRI (System of Rice Intensification) technique, soybean productivity was significantly higher even though without application of the AMF biofertilizer (Wangiyana *et al*., 2019).

In addition to drought conditions as the constraints for growing upland crops such as soybean and mungbean during the dry seasons following flooded rice, changing rice land from inundated to dry conditions can significantly reduce the availability of P nutrients for non-rice crops (Muirhead and Humphreys, 1996). In addition, after the use of land for growing flooded rice (conventional rice), especially after the second cycle of rice crop, the population of AMF becomes very low due to flooding even though rice is actually also a host plant for AMF (Ilag *et al*., 1987; Wangiyana *et al*., 2006, 2016). Soybean plants are also hosts for AMF, and soybean is classified as having a high degree of dependence on symbiosis with AMF (Anderson and Ingram, 1993). Soybean plants also require symbiosis with *Rhizobium* bacteria (Meghvansi and Mahna, 2009; Subramanian *et al*., 2011).

This study aimed to examine the residual effects of growing red rice under various techniques, including conventional and aerobic irrigation systems either in monocropping or additive intercropping with peanut, and application of various organic wastes to the rice plants on growth and yield components of soybean direct-dibbled following harvest of the red rice plants during the dry season.

II. MATERIALS AND METHODS

The field experiment in this study was conducted on paddy field in Beleke village of West Lombok, Indonesia (116º7'54" E; 8º39'29" S), from August to November 2019. The experiment for the red rice grown preceding this soybean was designed according to Split Split-Plot design consisting of three blocks, testing three treatment factors, i.e. techniques of rice cultivation as the main plot factor with four treatments (T1= conventional rice, T2= aerobic rice on raised-beds (ARR) without intercropping, T3= ARR additive-intercropped with peanut, T4= ARR additive intercropped with peanut and thin covered with rice straw mulch), row patterns of rice planting as the sub-plot factor with three treatments (R1= normal or single row, R2= double-row, R3= triple row), and application of organic wastes on the bed surface as the sub-subplot factor with four treatments (L0= without organic waste, L1= with rice husks, L2= with rice husk ash, L3= with rice husk ash and cattle manure). However, the residual effects of these treatment factors applied to the red rice on soybean direct-seeded without tillage following harvest of the red rice are reported here only on the double-row pattern (R2) of the red rice plants.

Before dibbling soybean seeds (Deja-1 variety supplied by the "Balitkabi" research center in Malang, East Java, Indonesia, after harvest of the red rice, the surface of the raised-beds and plots of the conventional rice were cleaned from weeds. Rice stubbles were cut near the raised-bed surface. When done, soybean seeds were dibbled in the base of the rice stubbles by burying 3-4 soybean seeds, which are then thinned at 10 days after seeding (DAS) to allow only two young soybean plants to grow until harvest date. Thinning was immediately followed with fertilization of the soybean plants using Phonska (NPK 15-15-15) fertilizer with a dosage of 200 kg/ha or 1.0 g/clump (based on 25x20 cm planting distances). The entire procedures for growing the red rice were explained in Dulur *et al.* (2019). Other maintenance for the soybean plants in the field included weeding at 3 and 6 weeks after planting (WAP), and pest control especially after pod setting using a systemic insecticide (Virtako 300 SC).

International journal of Horticulture, Agriculture and Food science(IJHAF)
Vol-4, Issue-5, Sep-Oct, 2020
https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

The observation variables included growth variables (plant height and leaf number at 2, 4, 6 and 8 WAP, average growth rate (AGR) of plant height, and dry stover weight), and yield components (pod number, grain number, weight of 50 grains, grain yield, and harvest index). Data were analyzed with analysis of variance (ANOVA) and Tukey's HSD at 5% level of significance, using CoStat for Windows ver. 6.303. Correlation analysis was done using Minitab for Windows Rel. 13.

III. RESULTS AND DISCUSSION

The summary of ANOVA results in Table 1 shows that between the two treatment factors tested, the techniques of growing the preceding red rice had more significant effects on growth and yield components of soybean following the red rice compared with the application of organic wastes to the preceding red rice crop. However, there was no significant interaction effects of the treatments applied to the preceding red rice crop on all growth variables and yield components of the soybean plants direct seeded following harvest of the red rice. In relation to yield components, both the treatment factors applied to the preceding red rice crop had significant residual effects on grain number and grain yield per clump of soybean direct seeded following harvest of the red rice crop. Both treatment factors also had a significant effect on the number of green leaves per clump at 8 WAP, which also showed a positive significant correlation with both grain number and grain yield per clump (Table 2).

Table 1. Summary of the effects of cultivation techniques and organic waste application to the preceding red rice crop on growth and yield components of soybean direct-seeded in the rice stubbles following harvest of the red rice crop

Treatments on cultivation of the preceding rice crop	AGR plant height (cm/day)	Plant height 8 WAP (cm)	Leaf number 8 WAP	Pod number per clump	Grain number per clump	Dry stover weight (g/clump)	Weight of 50 grains (g)	Grain yield (g/clump)	Harvest index (%)
Rice cultivation techniques (T):									
T1: conventional rice	1.53 b	79.5 c	9.4 b	26.0 a	67.6 c	20.37 a	7.36 a	9.89 d	33.0 c[1)]
T2: aerobic rice (AR)	1.64 a	84.3 b	10.2 ab	28.5 a	82.8 b	19.08 a	7.31 a	12.03 c	38.8 b
T3: AR+peanut	1.64 a	87.9 a	10.4 ab	29.6 a	106.3 a	17.28 a	7.18 a	15.22 b	47.1 a
T4: AR+peanut+mulch	1.60 a	84.7 b	10.8 a	29.4 a	114.7 a	20.17 a	7.68 a	17.57 a	46.8 a
HSD 5%	0.07	2.7	1.2	ns	12.2	ns	ns	1.85	5.4
Organic waste application to rice (L):									
L0: without org waste	1.60 a	84.3 a	9.4 b	27.0 b	88.3 b	17.84 a	7.31 a	12.89 c	41.7 a
L1: rice husks	1.57 a	82.8 a	10.1 ab	28.3 ab	92.7 ab	20.63 a	7.41 a	13.63 bc	39.7 a
L2: rice husk ash (RHA)	1.62 a	84.6 a	10.6 a	28.6 a	93.7 ab	19.49 a	7.35 a	13.74 ab	41.0 a
L3: RHA + cattle manure	1.62 a	84.7 a	10.8 a	29.7 a	96.6 a	18.95 a	7.46 a	14.45 a	43.3 a
HSD 5%	ns	ns	0.9	1.6	5.4	ns	ns	0.77	ns
Interaction effects	ns	ns	ns	ns	ns	ns	ns	ns	ns

[1)] Mean in each column with same letters indicates non-significant differences between levels of a treatment factor

Note on ANOVA results: ns = non-significant; s = significant (p-value < 0.05)

International journal of Horticulture, Agriculture and Food science(IJHAF)
Vol-4, Issue-5, Sep-Oct, 2020
https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

Table 2. Multiple correlation among selected observation variables of soybean direct-seeded following harvest of the preceding red rice crop treated with different cultivation techniques and application of various organic wastes

Selected observation variables	**Plant height at 8 WAP**	**Leaf number at 8 WAP**	**Pod number per clump**	**Grain number per clump**	**Dry stover weight per clump**	**Grain yield per clump**
Leaf number at 8 WAP	0.221					
p-value	0.132					
Pod number per clump	0.301	0.564				
p-value	**0.038**	**0.000**				
Grain number per clump	0.500	0.561	0.753			
p-value	**0.000**	**0.000**	**0.000**			
Dry stover weight per clump	-0.093	0.280	0.110	-0.048		
p-value	0.531	0.054	0.456	0.749		
Grain yield per clump	0.456	0.576	0.718	0.988	-0.008	
p-value	**0.001**	**0.000**	**0.000**	**0.000**	0.958	
Harvest index (%)	0.433	0.299	0.537	0.822	-0.593	0.803
p-value	**0.002**	**0.039**	**0.000**	**0.000**	**0.000**	**0.000**

Among the observation variables (excluding grain number per clump), harvest index had significant correlation coefficients with grain yield per clump (Table 2), with a correlation coefficient r = + 0.803 (p-value <0.001). This means that higher harvest index is related to higher grain yield of the soybean crop direct-seeded following harvest of the preceding red rice crop. Although dry stover weight of soybean following rice was not significantly different between techniques of rice cultivation, dry stover weight had a negative and significant correlation coefficient with harvest index, which means that higher harvest index corresponds to lower dry stover weight. Since dry stover weight is the remaining weight of soybean biomass that could not be transferred to the growing seeds for grain yield, then this negative correlation could mean that from the same initial biomass weight, higher harvest index will result in higher grain yield and lower dry stover weight due to higher proportion of the initial biomass that was partitioned to the growing seeds. According Sinclair and de Wit (1975), soybean, among seed plants, requires the highest amount of N per gram photosynthate required by the growing seeds, and this properties will force soybean to remobilize N from leaves to the growing seeds which could result in faster senescence of the green leaves during the seed-filling stages if N-supplying capacity of the root system is not sufficient.

It can also be seen from Table 2 that grain yield per clump also had a significant positive correlation (r= +0.576) with leaf number per clump at 8 WAP, which was the total number of the leaves that were still green per clump 8 WAP, which was in the middle of seed-filling stage of this soybean variety (Deja-1). This correlation indicates that higher grain yield per clump was supported by higher leaf number per clump at 8 WAP, which also means higher size of the source and higher photosynthate supplying capacity of the source (leaves) for the growing seeds, which resulted in higher grain yield per clump at maturity.

Since photosynthate supplying capacity depends on N-supplying capacity of soybean plants during seed-filling stage (Sinclair and de Wit, 1975), then for higher yield, soybean plants will also need soils with higher N-supplying capacity. From Table 1, it can be seen that grain yield of soybean, as well as harvest index, grain number and leaf number per clump at 8 WAP, was significantly affected by the techniques of growing the preceding red rice crop, and the higher grain yields of soybean correspond to higher harvest indices, higher grain number per clump, and higher leaf number per clump at 8 WAP.

Open Access

International journal of Horticulture, Agriculture and Food science(IJHAF)
Vol-4, Issue-5, Sep-Oct, 2020
https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

In relation to the treatments applied to the preceding red rice crop in this study, Table 1 shows that the highest grain yield per clump (17.57 g/clump) is on soybean plants direct-seeded following red rice grown under aerobic irrigation systems intercropped with peanut on raised-beds thin covered with rice-straw mulch (T4), followed by soybean plants (15.22 g/clump) direct-seeded following red rice grown under aerobic irrigation systems intercropped with peanut on raised-beds but without mulch application (T3), compared with grain yield only 9.89 g/clump on soybean plants direct-seeded following conventional rice; and the differences are significant.

The higher grain yield of soybean in T4 and T3 raised-beds, i.e. soybean direct-seeded following aerobic rice intercropped with peanut, compared with those following conventional rice was most probably due to the N-supplying capacity of the soil in T4 and T3 raised-beds because the preceding red rice crops were grown in intercropping with peanut in aerobic irrigation systems. Legumes are capable of establishing a symbiosis with *Rhizobium* bacteria but release a substantial part of the biologically fixed N into the rhizosphere, ranging from 4 to 71% (Fustec *et al*., 2009). Zhang *et al*. (2019) reported that N-rhizodeposition from peanut roots was averaged 35.7 kg/ha, which was available for uptake by wheat in a peanut-wheat rotation in China. According to results reported by Inal *et al*. (2007), intercropping maize with peanut significantly increased the availability of various macro nutrients in the rhizosphere of the intercrop compared with in the rhizosphere of each crop in monocrop. In addition, Lu *et al*. (2019) also reported that intercropping with peanuts in young tea plants significantly improved soil conditions in the following years due to increased nutrient contents in the soil, such as available N, Mg and exchangeable-Ca, compared with in the soil of monocropped crop, in addition to increases in soil organic matter, soil pH and populations of rhizosphere fungi and bacteria, but reduced levels of exchangeable-Al.

In addition to the significant effects of cultivation techniques applied to the preceding red rice crop, application of various organic wastes to the preceding red rice crops also significantly affected grain yield of soybean direct-seeded following harvest of the red rice crop (Table 1), in which grain yields, as well as grain number, pod number and leaf number per clump at 8 WAP, were higher on soybean direct-seeded following the red rice crops amended with rice husk ash + cattle manure (L3) or rice husk ash only (L2), when compared to without organic waste amendment (L0). In relation to these effects, Sari (2015) also reported that rice husk charcoals as well as fresh rice husks have the ability to suppress weed growth when compared to without the application of rice husk charcoal and fresh rice husks.

Although there was no significant interaction effects between the two treatment factors applied to the cultivation preceding red rice crop, it can be seen from Fig. 1 that amendment of the red rice crops either only with rice husk ash or with rice husk ash and cattle manure significantly increased grain yield of soybean direct-seeded following the preceding red rice crops cultivated on the permanent raised-beds in intercropping with peanut (both T3 and T4) or following conventional rice (T1), except following the aerobic rice on raised-beds without intercropping with peanut (T2).

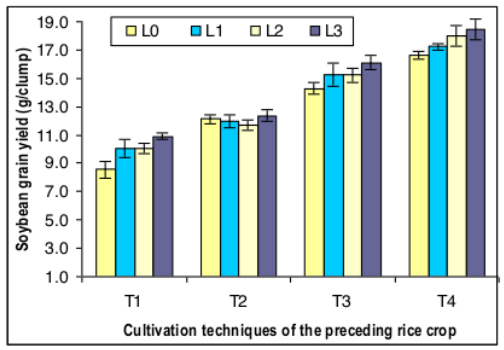

Fig. 1. Average (Mean ± SE) grain yield (g/clump) of soybean direct-seeded without tillage following red rice crop of different cultivation techniques amended with various organic wastes

This indicated the advantages of intercropping rice with peanut under aerobic irrigation system on permanent raised-beds compared with the conventional technique or application of rice husk ash or rice husk ash and cattle manure to the preceding rice crop on growth and grain yield of soybean direct-seeded following the red rice crop. This resulted in the highest average (18.43 g/clump or 3.69 ton/ha) grain yield of soybean direct seeded following T4 rice growing technique amended with rice husk ash and cattle manure, compared with only an average of 8.54 g/clump (or 1.71 ton/ha) on soybean direct-seeded following the conventional rice without amendment with organic wastes.

IV. CONCLUSION

It can be concluded that growth and yield components of

https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

soybean direct-seeded without tillage following rice crops can be significantly improved by growing rice under aerobic irrigation systems in intercropping with peanut instead of growing rice under conventional technique. Grain yield was highest (18.43 g/clump or 3.69 ton/ha) on soybean plants direct-seeded following aerobic rice grown on permanent raised-bed intercropped with peanut thin covered with rice straw mulch (T4) and amended with rice husk ash and cattle manure (L3), and lowest (8.54 g/clump or 1.71 ton/ha) on soybean plants direct-seeded following conventional rice (T1) without application of organic wastes (L0).

ACKNOWLEDGEMENTS

Through this article the authors express their gratitude to the Directorate of Research and Community Service and the Rector of the University of Mataram for the three-year research grants (2018-2020 budget year) provided through the "PDUPT" research grant scheme.

REFERENCES

[1] Adisarwanto, T., Suhendi, R., Sinaga, M.A. and Ma'shum, M. 1992. Kajian residu pupuk nitrogen untuk padi gora terhadap hasil kedelai yang ditanam setelah padi gora". **In**: Suyamto H., Achmad Winarto, Sugiono and Sunardi (Eds), *Risalah Seminar Hasil Penelitian Sistem Usahatani di Nusa Tenggara Barat*. Balai Penelitian Tanaman Pangan Malang, Malang.

[2] Aimon, H., dan Satrianto, A. 2014. Prospek Konsumsi dan Impor Kedelai di Indonesia Tahun 2015 – 2020. *Jurnal Kajian Ekonomi*, 3(5). http://ejournal.unp.ac.id/index.php/ekonomi/article/view/4157/3304.

[3] Aldillah, R. 2015. Proyeksi Produksi dan Konsumsi Kedelai Indonesia. *Jurnal Ekonomi Kuantitatif Terapan*, 8(1): 9-23.

[4] Anderson, J.M., and Ingram, J.S.I. 1993. *Tropical Soil Biology and Fertility: A Handbook of Methods*. 2nd edition. Wallingford, UK: CAB International.

[5] Bellaloui, N., Reddy, K.N., Bruns, H.A., Gillen, A.M., Mengistu, A., Zobiole, L.H.A., Fisher, D.K., Abbas, H.K., Zablotowicz, R.M., and Kremer, R.J. 2011. Soybean Seed Composition and Quality: Interactions of Environment, Genotype, and Management Practices. Pp 1-42. **In:** Maxwell, J.E. (Ed), *Soybeans: Cultivation, Uses and Nutrition*. New York, USA: Nova Science Publishers, Inc.

[6] Dulur, N.W.D., Wangiyana, W., Farida, F., and Kusnarta, I.G.M. 2019. Improved Growth and Yield Formation of Red Rice under Aerobic Irrigation System and Intercropping with Peanuts. *IOSR Journal of Agriculture and Veterinary Science* Vol. 12, Issue 8 Ser. I (August 2019), PP 12-17. http://iosrjournals.org/iosr-javs/papers/Vol12-issue8/Series-1/C1208011217.pdf

[7] Fustec, J., Lesuffleur, F., Mahieu, S., and Cliquet, J.B. 2010. Nitrogen rhizodeposition of legumes. A review. *Agron. Sustain. Dev*., 30: 57–66.

[8] Ilag, L.L., Rosales, A.M., Elazegui, F.A., and Mew, T.W. 1987. Changes in the population of infective endomycorrhizal fungi in a rice-based cropping system. *Plant and Soil*, 103:67-73.

[9] Inal, A., Gunes, A., Zhang, F., and Cakmak, I. 2007. Peanut/maize intercropping induced changes in rhizosphere and nutrient concentrations in shoots. *Plant Physiology and Biochemistry*, 45: 350-356.

[10] Lu, W., Shen, X., and Chen, Y. 2019. Effects of Intercropping Peanut on Soil Nutrient Status and Microbial Activity within Young Camellia oleifera Plantation. *Communications in Soil Science and Plant Analysis*, 50(10): 1232-1238.

[11] Meghvansi, M.K. and Mahna, S.K. 2009. Evaluating the Symbiotic Potential of Glomus intraradices and Bradyrhizobium japonicum in Vertisol with Two Soybean Cultivars. *American-Eurasian Journal of Agronomy*, 2: 21-25.

[12] Muirhead, W.A., and Humphreys, E. 1996. Rice-based cropping systems in Australia: Constraints to non-rice crops. pp.181-185. In: G. Kirchhof and H.B. So (Eds), Management of Clay Soils for Rainfed Lowland Rice-based Cropping Systems. Canberra, Australia: ACIAR.

[13] Sari, V.I. 2015. Pemanfaatan berbagai jenis bahan organik sebagai mulsa untuk pengendalian gulma di areal budidaya tanaman. *Jurnal Citra Widya Edukasi*, 7(2): 56-62.

[14] Sinclair, T.R., and de Wit, C.T. 1975. Photosynthate and nitrogen requirements for seed production by various crops. *Science*, 189: 565-567.

[15] Subandi, Harsono, A., and Kuntyastuti, H. 2013. Areal Pertanaman dan Sistem Produksi Kedelai di Indonesia, p. 104-129. **In:** Sumarno *et al*. (Eds), Kedelai: Teknik Produksi dan Pengembangan. Badan Penelitian dan Pengambangan Pertanian, Jakarta, Indonesia.

[16] Subramanian, K.S., Jegan, R.A., Gomathy, M., and Vijayakumar, S. 2011. Biochemical and Nutritional Responses of Tripartite Soybean-Rhizobium-Glomus Association Under Low and High P Fertilization. *Madras Agric. J*., 98: 224-228.

[17] Suryana A. 2008. Penganekaragaman pangan dan gizi: faktor pendukung peningkatan kualitas sumberdaya manusia. *Majalah Pangan. Media Komunikasi dan Informasi* No 52/VXII/Oktober-Desember 2008, Jakarta.

[18] Wangiyana, W., and Farida, N. 2019. Application bio-fertilizers to increase yields of zero-tillage soybean of two varieties under different planting distances in dry season on vertisol land of Central Lombok, Indonesia. AIP Conference Proceedings 2199, 040009 (2019); DOI: https://doi.org/10.1063/1.5141296.

[19] Wangiyana, W., Cornish, P.S., and Morris, E.C. 2006. Arbuscular Mycorrhizal Fungi Dynamics in Contrasting

International journal of Horticulture, Agriculture and Food science(IJHAF)
Vol-4, Issue-5, Sep-Oct, 2020
https://dx.doi.org/10.22161/ijhaf.4.5.2
ISSN: 2456-8635

Cropping Systems on Vertisol and Regosol Soils of Lombok, Indonesia. *Experimental Agriculture (Cambridge)*, 42: 427–439.

[20] Wangiyana, W., Cornish, P.S., and Ryan, M.H. 2016. Arbuscular Mycorrhizas in Various Rice Growing Environments and their Implication for Low Soybean Yields on Vertisol Soil in Central Lombok, Indonesia. *IOSR - Journal of Environ. Science, Toxicology and Food Technology*, 10(12), Ver.III: 51-57.

[21] Wangiyana, W., Dulur, N.W.D., and Farida, N. 2019. Mycorrhizal Inoculation to Increase Yield of Soybean Direct-Seeded Following Rice of Different Growing Techniques in Vertisol Soil, Lombok, Indonesia. *International Journal of Environment, Agriculture and Biotechnology*, 4(3): 884-891.

[22] Zhang, K., Zhao, J., Wang, X.Q., Xu, H.S., Zang, H.D., Liu, J.N., Hu, Y.G., Zeng, Z.H. 2019. Estimates on nitrogen uptake in the subsequent wheat by aboveground and root residue and rhizodeposition of using peanut labeled with ^{15}N isotope on the North China Plain. *Journal of Integrative Agriculture*, 18(3): 571–579.

IJHAF_2020-4-5_Dulur-Wy-Nihla-Kus_Growth-n-yield-of-soybean.pdf

ORIGINALITY REPORT

8%	6%	5%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Massey University Student Paper	1%
2	S.K Patil, U Singh, V.P Singh, V.N Mishra, R.O Das, J Henao. "Nitrogen dynamics and crop growth on an Alfisol and a Vertisol under a direct-seeded rainfed lowland rice-based system", Field Crops Research, 2001 Publication	1%
3	ageconsearch.umn.edu Internet Source	1%
4	cropagro.unram.ac.id Internet Source	1%
5	Joëlle Fustec. "Nitrogen rhizodeposition of legumes. A review", Agronomy for Sustainable Development, 2009 Publication	<1%
6	repo.unand.ac.id Internet Source	<1%

7	Nicolás Marro, Noelia Cofré, Gabriel Grilli, Carolina Alvarez, Diana Labuckas, Damián Maestri, Carlos Urcelay. "Soybean yield, protein content and oil quality in response to interaction of arbuscular mycorrhizal fungi and native microbial populations from mono- and rotation-cropped soils", Applied Soil Ecology, 2020 Publication	<1 %
8	www.poultryscience.org Internet Source	<1 %
9	d-nb.info Internet Source	<1 %
10	www.supagro.fr Internet Source	<1 %
11	www.thepharmajournal.com Internet Source	<1 %
12	R D Yofa, R P Perdana, R Aldillah, C Muslim, Sunarsih, A Agustian. "Strategies to increase soybean production by increasing the distribution of new superior varieties", IOP Conference Series: Earth and Environmental Science, 2021 Publication	<1 %
13	ia803400.us.archive.org Internet Source	<1 %

14	Biofortification of Food Crops, 2016. Publication	<1%
15	Fukai, Shu, and Makara Ouk. "Increased productivity of rainfed lowland rice cropping systems of the Mekong region", Crop and Pasture Science, 2012. Publication	<1%
16	Kai ZHANG, Jie ZHAO, Xi-quan WANG, He-shui XU, Hua-dong ZANG, Jing-na LIU, Yue-gao HU, Zhao-hai ZENG. "Estimates on nitrogen uptake in the subsequent wheat by above-ground and root residue and rhizodeposition of using peanut labeled with 15N isotope on the North China Plain", Journal of Integrative Agriculture, 2019 Publication	<1%
17	dokumen.pub Internet Source	<1%
18	ejournal.unib.ac.id Internet Source	<1%
19	sinta3.ristekdikti.go.id Internet Source	<1%
20	www.fao.org Internet Source	<1%
21	www.ijemr.net Internet Source	<1%

22	www.science.gov Internet Source	<1 %
23	Yanfang Xue, Haiyong Xia, Peter Christie, Zheng Zhang, Long Li, Caixian Tang. "Crop acquisition of phosphorus, iron and zinc from soil in cereal/legume intercropping systems: a critical review", Annals of Botany, 2016 Publication	<1 %

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		

IJHAF_2020-4-5_Dulur-Wy-Nihla-Kus_Growth-n-yield-of-soybean.pdf

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7