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Utilization of plantation land for increasing Indonesian soybean production

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Abstract. To meet the increasing demand for soybeans in Indonesia, it is necessary to increase the production rate. One way to do that is by utilizing the plantation land. The study was conducted by planting five Indonesian soybean varieties under the Sengon (Chinese albizia) tree, under a pine tree and next to the soursop tree. The data analysis used 2-factor experimental design with a confidence level of 95% and used a random model. From the results of the study it was found that there was no effect on the use of various types of Indonesian soybean varieties and the planting location toward the crop production. On the other hand, for the interaction of the use of various types of Indonesian soybeans and planting locations there was a slight influence on the crop production. Indonesian soybean production planted under Sengon trees is in an average of 2.4 kg/10mx 10m. The soybean planted under pine trees produced average of 2.5 kg/10mx 10m, while soybean planted next to soursop trees is in average of 2.3 kg/10mx 10m. Therefore, it can be concluded that plantation land does not affect the production of Indonesian Soybean. Each Indonesian soybean variety has its own production profile, as stated by its discoverer.

Keywords: Indonesian soybean, plantation land, production result

1. Introduction

Soybean demand is much greater than the supply of available soybeans. It is estimated that until 2019 Indonesia will still import soybeans at 229% [1]. So a strategy is needed to meet the needs of imported soybeans not to grow alone, but with domestic soybean production [2]. The acceleration of production increase can be done through intercropping, utilizing Perhutani land, plantation land and abandoned land [3].

This study is a verification of previous research, namely "The Model of Soybean Production Inventory Strategy in Domestic Production to Achieve Self-Sufficiency". All variables that have been found same researchers in the research dissertation must be verified in advance. If it has been proven true then it can be applied. One of the independent variables from the soybean inventory strategy model is domestic production, which is a novelty of researchers in the completion of a dissertation namely land and intensification (X5), [4, 5, 6, 7, 8] with indicators, namely: 1) Planting Monocultures [6, 9] Planting intercropping at least 2 kinds, [1, 5]. 3) Planting throughout the year [5, 10]. 4) Utilization of abandoned land [6, 10, 11, 12, 13, 14, 15, 16, 17]. 5) Utilization of Perhutani land, plantations and other land [1, 3, 10]. The dependent variable is High Production Variable (Y1), through productivity and area expansion [10] with indicators namely: Increased Planting Areas [18, 19, 20] and Land Use Conversion [6, 8, 17].

This paper is one of the topics of study from the second year of verification of the model found by researchers. The purpose of this study is to verify the indicators of the newly discovered model. Where the indicators of monoculture planting and planting throughout the year have been carried out in the first year research. The specific purpose of this study is to find out whether the amount of Indonesian soybean production is influenced by the location of planting. In this paper the planting locations used are the Perhutani land and plantations.

Research conducted by researchers in the first year has never been done by other researchers before, especially planting throughout the year. This is likely because it is difficult to find experimental land and time to conduct experiments. Researchers felt called because it was conveyed by the National Atomic Batan Agency [6] that imported soybean only remains pulp and is GMO. Other than that researchers felt surprised by the fact that soy has very high protein content of 44% while meat which costs 12 times only has 19% protein content [6]. The important thing is that the results of the research of the dissertation of researchers found a model of domestic soybean supply strategy to achieve self-sufficiency. Further research must be conducted to get answers to the question whether it is true that soybean deficits can be reduced and gradually, self-sufficiency can be achieved. From the results of the first year research it can be concluded that although planted in another location from the location of breeding/discovery of seedlings, planted at any time, with intercropping methods and with very simple cultivation methods, Indonesian soybeans can grow and produce with high amounts in accordance with the expected average of 2.3 tons / ha - 3 tons / ha, still within the limits of the profile of each seed. The average tree height of 50 cm is not much different from the profile of 50.5 cm. Likewise for the average selling price of IDR 8,000/kg for consumption whereas for industrial use, the average price is IDR 25,000/kg. The results of this verification study become novelty for researchers. So far, farmers believe that domestic soybean production does not grow if it is planted on the ground and at any time let alone to produce high-quality and high-quality production at reasonable prices. The independent variable in year 1 is to produce high productivity with the dependent variable being the availability of soybeans with an indicator of producing high production and having a reasonable and stable selling price. The second year research was intercropping while in the first year research the planting was carried out by monoculture. All experiments were carried out in locations that were far apart from each other, different districts, in Malang district, East Java province. Planting using plantation land has been carried out by previous researchers, among others, under teak trees, under eucalyptus trees and beside palm oil trees. In this study, researchers conducted research under the planting of teak trees that have other plants, namely soursop and cayenne pepper, planting in vegetable gardens with eggplant, chili and corn. This planting is at the request of a vegetable farmer as the land owner hired for researchers to do research. Researchers also planted in addition to soursop and guava trees planted with green mustard greens, cayenne pepper, this experiment was also at the request of the landowner who was a fruit and vegetable farmer. All farmers who were invited to plant soybeans were non-soybean farmers.

The results of this study will make major contributions including: 1) The government as the party responsible for meeting the needs of soybean commodities to the community. 2) Soybean farmers who have a concern for the community other than as a livelihood, so that they will conduct soybean farming in accordance with the recommended research results. 3) Indonesian people who need soybeans every day in large quantities. 4) Other related parties / community concerned about the supply of domestic soybean production. 5) It is expected that the results of this study can be applied in all regions of Indonesia by adjusting existing conditions so that in the end Indonesia can achieve self-sufficiency in domestic production of soybeans [21].

2. Research methods

The research was carried out experimentally by applying 5 superior Indonesian soybean seeds planted in 3 locations. Selection of soybean varieties based on consideration of shape, size and color profiles, is almost identical to imported soybeans and high production yields. The choice of location is based on the availability of land for experimentation which later becomes a new discovery / novelty for researchers, because previous researchers (among others, who become references / references in dissertation

research) have planted under teak trees, under eucalyptus trees and under palm oil trees. Processing and analyzing data was conducted using experimental design. The experimental design used was in accordance with the treatment carried out. In the first year of the research, the design used was block design, square design and design of 2 factors and design with 3 factors. In the second year research the data analysis used was random block design, sub sampling block design and 2 factor design while for square design and 3 factor design were not used, this is because the independent variables used were only 2, namely soybean seed types and location of planting while the third variable is time is not analyzed anymore, because it has been done in the first year and the results are known that there is no effect of production results on planting time, also all the time during 12 months has been researched. Also for the square design that becomes the analysis decision only on the independent variables that are considered the most important of the 3 variables in this case, namely soybean varieties. From the results of the analysis with the design of 3 factors both random and fixed models the results obtained are all insignificant / have no effect except interactions from AXBXC (i.e. interactions between Soybean Varieties, Planting Location and Planting Time) but the effect is not too large, this is appropriate as a matter of fact, as stated in the theory that the more factors used the longer the analysis and the more combinations of treatments. It is often proven that with a high order interaction effect (more than 2 factors), the results are rarely significant. Treatment interaction should be done for 2 factors, while for 3 or more factors, they are combined with errors. Also all models used are random models [22, 23, 24], this is because in Indonesian soybean cultivation, there have been many varieties found. The model used is random which means the conclusions apply to all other soybean production varieties in the country, for planting locations others and for any time during planting [22, 23].

3. Results and discussion

Before conducting the experiment, the researcher gave direction in accordance with the theory and guidelines of the soybean crop research and development unit, the agriculture department especially food crops, Jember Regency, East Java Province, Indonesia [25]. Briefing was given to the research coordinator in this case farmers who owned land and to field assistants in this case farmers who lived around the experimental land. For data analysis, as stated in the research method above, design analysis should be sufficient to use a 2-factor design. The data in table 1 is one of the study topics from the results of the second year of research, namely the use of garden land, because not only soybean varieties are planted, but there are already other plants on the land. Planting which consist more than one type of plant is called intercropping planting method. In this second year study, intercropping was done not only by experimentation from the data in table 1, but there were several treatments including planting with 3 kinds of vegetables, planting in guava gardens with mustard greens and cayenne pepper, planting under teak gardens which have been planted with soursop fruit trees. All intercropping planting methods are carried out in accordance with the conditions of the available land, namely the farmer's property, the owner of the land borrowed by the researcher to conduct the research, which is in accordance with the objectives of this study, namely verification of land use and intensification. In table 1 is data from one of the study topics from this 2-year study, which is to find out the results of the production of 5 superior varieties of Indonesian soybeans grown in the sengon tree garden, in the pine tree garden and in the soursop tree garden. After conducting Indonesian Soybean cultivation starting from soil processing, planting, fertilizer application, care, harvesting, drying, threshing and finally cleaning, then weighing is then carried out to the tofu businessman. All work is carried out by field assistants (farmers who are around the site). The soybean produced is valued at Rp.8,000 / kg for consumption and industry and valued at Rp.25,000 / kg if used for seedlings. Data were randomly drawn as many as 3 plots of 10 m x 10 meter planting area. From the experimental results, the following results are obtained:

Table 1. Production of 5 Indonesian soybean varieties and planting locations (kg/10m x 10m)

Planting Location (B)	Soybean Variety (A)					Amount	Average
	Raja Basa	Mutiara 1	Dena 1	Dega 1	Grobogan		
Under Sengon Tree	1.8	2.4	2.3	2.1	2.7		
	1.9	2.7	2.5	2.4	2.9		
	2.1	2.5	2.4	2.4	2.8		
Amount	5.8	7.6	7.2	6.9	8.4	35.9	
Average	1.9	2.5	2.4	2.3	2.8	-	2.4
Under Pine Tree	2.2	1.9	2.3	2.1	2.8		
	2.4	2.2	2.5	2.4	3.0		
	2.2	2.2	2.3	2.2	2.9		
Amount	6.8	6.3	7.1	6.7	8.7	35.6	
Average	2.7	2.1	2.4	2.2	2.9	-	2.5
Beside Soursop Tree	2.1	2.2	2.4	2.3	2.3		
	2.2	2.4	2.2	2.5	2.4		
	2.3	2.2	2.5	2.5	2.3		
Amount	6.6	6.8	7.1	7.3	7.0	34.8	-
Average	2.2	2.3	2.4	2.4	2.3	-	2.3
Grand Total	19.2	20.7	21.4	20.9	24.1	106.3	
Average	2.1	2.3	2.4	2.3	2.7		2.4

Hypothesis: There is no difference in the use of the type of seed, the location of planting and the interaction of the type of seed and the location of planting on the yield/production:

$$(\sigma^2 A) = 0; (\sigma^2 B) = 0; (\sigma^2 AB) = 0 \tag{1}$$

Data Processing:
Data processing is performed using the corresponding formulas [22, 23],

$\sum Y^2 = (1.8)^2 + (1.9)^2 + \ldots + (2.4)^2 + (2.3)^2 = 253.69$

$Ry = (106.3)^2 / 5 \times 3 \times 3 = 251.10$

$Ay = (19.2)^2 + (20.7)^2 + (21.4)^2 + (20.9)^2 + (24.1)^2 / 3 \times 3 - 251.10 = 1.423$

$By = (35.9)^2 + (35.6)^2 + (34.8)^2 / 5 \times 3 - 251.10 = 0.047$

$Jab = 1/5 \{(6.8)^2 + (63)^2 + \ldots + (7.3)^2 + (7.0)^2\} - 251.10 = 99.884 - 251.10 = -151.216$

$ABy = (-151.216) - 1.423 - 0.047) = -152.686$

$Ey = 253.69 - 251.10 - 1.423 - 0.047 - (-152.686) = 153.806$

Continued data analysis according to the formula of the experimental design theory [22, 23],

Data Analysis:
For random models, the calculated F (sample)/treatment value is obtained by the formula:

$$A = A/AB; B = B/AB; AB = AB/E \tag{2}$$

Table 2. Analysis of variance of 5 types of Indonesian soybean seeds and 3 planting locations.

Variation Source	Degree of Freedom	Sum of Squares	Average of Sum of Squares	F Count
Average	1	251.10	251.10	
Treatment :				
Soybean Variety (A)	4	1.423	0.3557	0.018
Planting Location (B)	2	0.047	0.0235	0.001
Interaction (A*B)	8	152.686	19.085	3.712
Error	30	153.806	5.126	

The value of F table (population) with a confidence level of 95%from table F is obtained as follow:
$F_{0,05}$ Variety (4.8) = 3,84; $F_{0,05}$ Planting Location (2.8) = 4,46 ; $F_{0,05}$ Interaction (8.30) = 2.27

From table 2 it can be seen that F arithmetic (A) and (B) <F table, then the hypothesis is accepted, meaning that there is no effect of production due to the variety, as well as for the location of planting, This is consistent with the fact that each type of seed has each profile that has been discovered by its breeders planted at the breeding site. F arithmetic (AxB)> F table, then the hypothesis is rejected, meaning that there is an influence of production results due to the interaction between varieties and planting locations, but the effect is very little. From the results of the study it was proven that soybeans can grow and produce high amounts in accordance with the profile even if planted in locations other than Tegal, this is a novelty researcher. So far, farmers are worried that they will not grow, let alone produce. The results showed no difference in the yield of various soybean varieties planted with intercropping in pine, sengon and soursop gardens. The difference in the production of various varieties that occur is not due to intercropping planted in pine, sengon and soursop gardens, but indeed each soybean has its own profile.
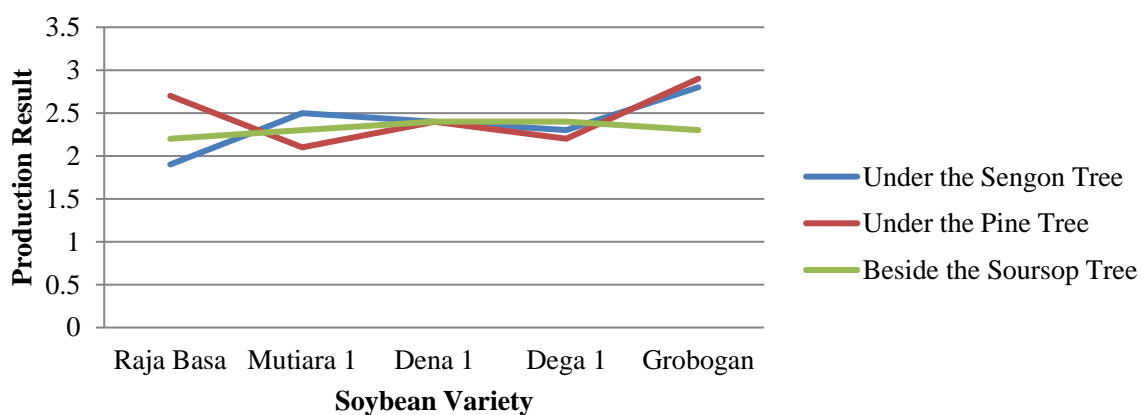

Figure 1. Production average in 3 planting locations.

Figure 1 showed that the planting location on under pine tree produces higher production [23]. The Result of the Study is shown in Figure 2 :
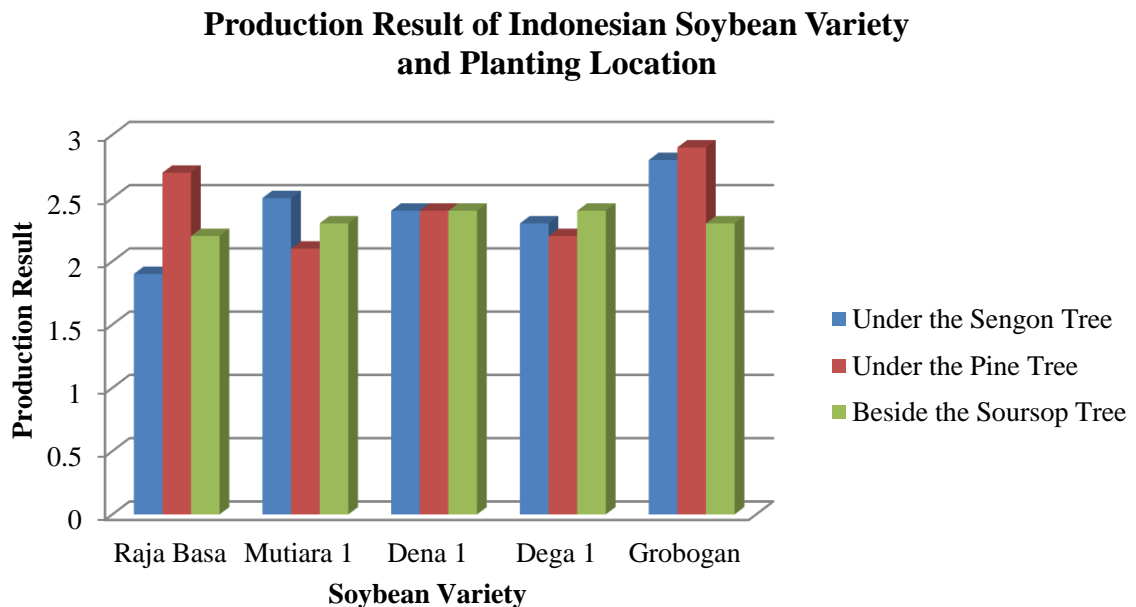
**Production Result of Indonesian Soybean Variety
and Planting Location**

Figure 2. Production average in 3 planting locations.

From Figure 2 it can be seen that for Soybean of Grobogan produces higher production both those planted in the sengon tree gardens and those planted in the pine tree plantations. The difference in yield is not influenced by the location of planting, but each type of soybean seed has its own profile. For shapes, sizes and colors, they produced exactly the same as the seeds used. Profile of the yields of each variety are as follows (Source: UPTD Bangsal sari Jember, BATAN Bandung and Balitkabi Malang, East Java Province, Indonesia): (in Ton / Ha)

1. Rajabasa : Potential result 2.05 – 3.9
2. Mutiara 1 : Potential result 2.4 – 4.1
3. Dega 1   : Potential result 2.78 – 3.82
4. Dena1   : Potential result 1.7 – 2.9
5. Grobogan : Potential result 2.77 – 3.4

Soybean has a profile of each other than the potential production results, which include: diameter, color, leaf width, height of the tree, as well as in different uses, for example for tempeh, tofu, soy sauce, medicines, beauty, milk, flour, meat Imitation, Salad Oil, M. Fried, White Butter, Margarine, Wetting Agent, Solvent, Emulsifier, Stabilizer, Lubricant, Rerotlen, Ice Cream, Yogurth, Baby Food, Soy Cheese, and others. (Soybean industrial tree, Marwoto and Hilman, Y.2005: 14, in Nelly [21], et al, Dissertation p.25).

4. Conclusions
1. The use of Indonesian soybean seeds does not affect the yields obtained. Each variety has its own profile.
2. The location of planting Indonesian soybeans does not affect the crops obtained.
3. The interaction between the type of seedlings and the planting location has very little effect on the crops obtained.
4. Indonesian soybean production planted under Sengon trees has an average of 2.4 kg / 10mx 10m.
6. Indonesian soybean production under Pine trees has an average of 2.5 kg / 10mx 10m.

7. Indonesian soybean production planted beside Soursop trees has an average of 2.3 kg / 10mx 10m.

8. The results of this study indicate that Indonesian soybean seedlings can be planted in various locations and at various times, while also produces high production according to their respective profiles

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