Nutrient Content Of Soybean Varieties Under Dry Land Conditions As Affected Of Technological Packages Application

Yaya Hasanah, Hamidah Hanum

Abstract: The content of N, P and K for some variants of soybeans can be influenced by the technological packages used under dryland conditions. The objective of the research was to determine the content of N, P, K of shoot soybean cultivars with the application of the technological packages under dryland conditions. This research used a Factorial Randomized Block Design with 2 factors and 3 replications. The first factor was soybean cultivars (Demas, Anjasmoro, Dering, Devon). The second factor was the use of soybean cultivation technology packages on dryland (package 1, package 2 and package 3). The parameters of observations were N, P and K content of shoot soybean varieties. Data were analyzed using the ANOVA procedure, the SAS version 12 computer program and comparison of means were tested for significance using Duncan Multiple Range Test (DMRT) p = 0.05. There is a difference in the response of soybean varieties to the application of the technological package used. The use of the P_3 technology package (fertilizer (Urea 25 kg / ha), inoculant B. japonicum 200 g / 40 kg of seed, SP-36 250 kg / ha, KCl 150 kg / ha, spacing 40 cm x 20 cm, dolomite 2,000 kg / ha, farmyard manure 5 tons/ha, maximum tillage , ascorbic acid antioxidant 300 ppm) in the Anjasmoro variety produced the highest P and K content, while the use of the P_2 technology package (Fertilizer (Urea 25 kg / ha), inoculant B. japonicum 200 g / 40 kg of seed, SP-36 150 kg / ha, KCl 100 kg / ha, dolomite 1,000 kg / ha, spacing of 40 cm x 20 cm, farmyard manure 2 tons / ha, maximum tillage, ascorbic acid antioxidant 200 ppm) in Dering variety produced the highest N plant content. It concluded that the best treatment for increasing the content of P and K for Anjasmoro variety is the application of the P_3 technological package (SP-36 150 kg/ha, KCl 100 kg/ha), but the application of P_2 technological package in Dering increased the N content

Keywords: soybean, dryland condition, nutrient, technological package

1. INTRODUCTION

Soybeans are the most important commodity in food crops because soybeans are rich in vegetable protein that is needed to improve public health. In addition, soybeans contain secondary metabolites of isoflavones which are beneficial in preventing osteoporosis (Zheng and Chun, 2016). antiestrogenic activity (Wang et al., 2013 ; Yoon and Park, 2014), dementia (Patisaul and Jefferson, 2010), and cancer [5]. The isoflavone content in soybean seed is influenced by abiotic and biotic factors such as water deficit, temperature, nutrient content, UV light, pathogens, wounding and interaction of plant microbe (Chennupati et al., 2012 ; Phommalth et al., 2008 ; Hasanah et al., 2018 ; Hasanah et al., 2014 ; Hasanah and Sembiring, 2018a ; Hasanah and Sembiring, 2018b)

The increasing of soybean needs is not in line with the increasing in soybean production. Planting in new planting areas and productivity of 1.5 tons per ha, will encourage an increase in production of 2.9 million tons. While the total national soybean needs are 2.4 million tons. The national average soybean production is 800,000 - 1 million tons per year. The deficiency of production was fulfilled by imports of soybeans from the United States (Alfi, 2017). In line with the Government program that dryland is one of the areas for developing national soybean production, some efforts are needed to increase the soybean production on dry and by referring to the characteristics of dry land. Dryland is sub-optimal land that have the potential to be developed as agricultural land, but have a number of problems including the infertile soil, react to acid, and contain high amounts of Al, Fe and or Mn. Dry land also has less organic matter and macro nutrients of N, P, K, Ca and Mg and also experience water shortages especially in the dry season which causes drought stress (Balai Penelitian Aneka Kacang dan Umbi, 2015 ; Hasanah et al,. 2015 ; Hasanah et al,. 2018a). The low productivity of soybeans is due to the fact that farmers have not used the soybean cultivation technological package in accordance with the characteristics of dry land. In this study several technological packages were used by using biofertilizers, organic fertilizers, addition of dolomite lime to increase pH, and antioxidant ascorbic acid. The use of soybean cultivation technological packages will have an impact on nutrient content in soybeans. Analysis of plant tissue is more practical to determine nutrient status in soybean plants than other methods. Nutrient status in plant tissue is also an illustration of nutrient status in the soil. This is based on the principle that the concentration of an nutrient in plants is the result of interactions of all factors that influence the absorption of these elements from the soil (Liferdi, 2000). This is based on the principle that the concentration of nutrients in plants is the result of interactions of all the factors that affect the absorption of these elements from the soil. Tissue analysis has been used as a reference in diagnosing nutrient problems and as a basis for assessing fertilization on fruit plants in various countries (Smith, 1962). Until now there is still limited information about the effect of using soybean cultivation technological packages under dry land condition and its effect on nutrient content of N, P and K on soybean varieties. Therefore this study aimed to evaluate the nutrient content of N, P and K soybean plant by using several soybean cultivation technology packages under dryland condition.

- *Yaya Hasanah and Hamidah Hanum, affiliated Faculty of Agriculture, Universitas Sumatera Utara Jl. Prof. A. Sofyan no 3 Kampus USU Medan 20155- Indonesia*
- *Corresponding author : Yaya Hasanah, Faculty of Agriculture, Universitas Sumatera Utara, Medan 20155, Indonesia. PH. +62618213236. E-mail: yaya@usu.ac.id*

2 MATERIALS AND METHODS

2.1 Characteristics of the Research Site

This research was carried out under dryland conditions in Tanjung Jati Village (Langkat) on June to September 2018. The agro-climate characteristics of the research site are average monthly rainfall by 170.67, average monthly temperature is 27.6°C, minimum monthly temperature is 21.6 °C and monthly maximum temperature is 32.5°C, temperature average monthly is 27.6°C. Soil characteristics are; total P content is 0.13%, total K is 0.13%, N is 0.19%, and pH is 5.12. Analysis of N, P and K contents was carried out in PT Socfin's Indonesia Analysis Laboratory. The research materials used were soybean varieties (Devon 1, Demas, Dering and Anjasmoro), fertilizer of Urea, TSP and KCl, dolomite lime, insecticides, fungicides, ascorbic acid, spectrophotometer.

2.2 Methods

Experimental Design and Crop Management

Treatments were arranged in a Randomized Block Design with 2 factors and three replications. The first factor was two soybean cultivars (Demas, Anjasmoro, Dering and Devon). The second factor was application of technology package as shown in Table 1. Soybean seeds planted were inoculated with Bradyrhizobium japonicum. Planting was done in the morning, using a spacing of 40 cm x 20 cm. Sources of N, P and K were used according to treatment and referred to the package of soybean cultivation technology on dryland (Table 1). Urea fertilizer was given a half dose at planting and the rest at 4 week after planting. TSP and KCl fertilizers were given entirely during planting. Weed control was done manually according to field conditions. The variables observed included the content of N, P and K of soybean shoot. N was analyzed using the Kjedahl-Spectrophotometry method, involved three major steps are digestion (organic nitrogen is converted into NH_4^+), distillation (NH_3 is distilled and retained in a receiver vessel) and titration (nitrogen is determined) (Sri, 2018)

***Tabel 1** Technologycal package of soybean cultivation under dry land condition*

Technologycal package of soybean cultivation	Input
P1=packages 1	Fertilizer (Urea 25 kg/ha), inoculant B. japonicum 200 g/40 kg of seed, SP-36 100 kg/ha, KCl 50 kg/ha, spacing 40 cm x 20 cm, dolomite 500 kg/ha, farmyard manure 2 ton/ha, maximum tillage, antioxidant ascorbic acid 100 ppm.
P2=packages 2	Fertilizer (Urea 25 kg/ha), inoculant B. japonicum 200 g/40 kg of seed, SP-36 150 kg/ha, KCl 100 kg/ha, spacing 40 cm x 20 cm, dolomite 500 kg/ha, farmyard manure 2 ton/ha, maximum tillage, antioxidant ascorbic acid 200 ppm
P3 = packages 3	Fertilizer (Urea 25 kg/ha), inoculant B. japonicum 200 g/40 kg of seed, SP-36 250 kg/ha, KCl 150 kg/ha, spacing 40 cm x 20 cm, dolomite 500 kg/ha, farmyard manure 5 ton/ha, maximum tillage, antioxidant ascorbic acid 300 ppm

K used the Atomic Absorption Spectrophotometry analysis method. Determination of P concentration was measured by UV-VIS Spectrophotometer. Chemical analysis was carried out based on the procedure issued by Yoshida et al. [18]

2.2 Statistical analysis

The data was subjected to two way analysis of variance (ANOVA) procedures, the SAS version 12 computer program and comparison of means were tested for significance using Duncan's Multiple Range Test (DMRT) p= 0.05.

3. RESULTS AND DISCUSSIONS

3.1. Result

N content

The results showed that there were significant interactions between varieties and technological packages of soybean cultivation under dryland conditions tested. Based on Table 2, it can be known that the use of the P_3 technology package on the Dering variety produced the highest N content (2.86%). Actually the technology package P_1, P_2 and P_3 has the same N fertilizer treatment that is Urea 25 kg/ha, but the responsiveness of each variety to the use of technological packages is different. The increasing of application of P and K fertilizer in P_1 to P_3 technological packages in Dering variety has increased the N content in plants by 19% (increase from 2.31% to 2.81% of N content).

***Table 2**. N content of soybean varieties with application of technological packages under dryland conditions*

Variety	Technological package			Mean
	P_1	P_2	P_3	
	………… % …………			
V_1 (Demas)	2.67c	2.49f	2.30j	2.49
V_2 (Anjasmoro)	2.33i	2.37g	2.62c	2.44
V_3 (Dering)	2.31i	2.58d	2.86a	2.58
V_4 (Devon	2.72b	2.41g	2.51e	2.54
Mean	2.51	2.46	2.57	

Means followed by a different letter are significantly different Duncan's Multiple Range Test (P ≤ 0.05)

P Content

The results showed that there were significant interactions between varieties and the use of technological packages on the P content of soybean plants. The interaction between Anjasmoro varieties and the use of the P3 technology package produced the highest P content of the plant (0.33%) compared to other treatment interactions. Increasing the P content of P1 by 150 kg TSP / ha to 250 TSP / ha on P3 increased the shoot content of P in the Anjasmoro variety by 30.33% (0.23% in P1 to 0.33% in P3). This showed that the Anjasmoro variety is very responsive to the application of P_3 technological package.

***Table 2**. P content of soybean varieties with application of technological packages under dryland conditions*

Variety	Technological package			Mean
	P_1	P_2	P_3	
	…………… % ………………..			
V_1 (Demas)	0.29c	0.25g	0.27e	0.27
V_2 (Anjasmoro)	0.23i	0.29c	0.33a	0.29
V_3 (Dering)	0.24h	0.24h	0.23i	0.24
V_4 (Devon	0.32b	0.27f	0.28d	0.29
Mean	0.27	0.26	0.28	

Means followed by a different letter are significantly different Duncan's Multiple Range Test (p ≤ 0.05)

K Content

The results showed that there were significant interactions between varieties and the use of technological packages on the K content of soybean plants. The interaction between the Demas variety and the use of the P2 technology package produced the highest K plant content (2.69%) compared to other treatment interactions. In Demas variety, an increase in K application to P1 of 50 kg KCl / ha to 100 KCl / ha in P2 increased shoot content of K by 7.43% (2.49% in P1 to 2.69% in P2), but an increase in KCl fertilizer to 150 kg / ha reduced the K content of soybean plants by 13.4% (2.69% in P2 to 2.33% in P3). This showed that soybean plants have a certain capacity to absorb K nutrient.

***Table 2**. K content of soybean varieties with application of technological packages under dryland conditions*

Variety	Technological package			Mean
	P_1	P_2	P_3	
	……… % ……………			
V_1 (Demas)	2.49c	2.69a	2.33e	2.50
V_2 (Anjasmoro)	2.41d	2.57b	2.49c	2.49
V_3 (Dering)	2.10h	2.19g	2.09h	2.13
V_4 (Devon)	2.26f	2.18g	2.28f	2.24
Mean	2.32	2.41	2.30	

Means followed by a different letter are significantly different Duncan's Multiple Range Test (P ≤ 0.05)

Shoot Root Ratio

Based on Table 4, it can be seen that Demas variety has the highest shoot root ratio (6.17), which indicated that Demas shoot growth was higher than the root. This was understandable because Demas is an acid-free dryland tolerant soybean. The research location is classified as acid dryland (pH 5.12). In accordance with Balai Penelitian Aneka Kacang dan Umbi (Reseach Centre of Legumes and Tubers, 2015) statement that the Demas 1 variety can be cultivated on acidic dryland with a pH of 4.5 -5.5 without the addition of soil pH-enhancing materials. In this environmental diversity, this variety is able to provide optimal seed yields.

***Table 4**. Shoot Root ratio of soybean varieties with application of technological packages under dry land conditions*

Variety	Technological package			Mean
	P_1	P_2	P_3	
V_1 (Demas)	6.22	6.12	6.18	6.17
V_2 (Anjasmoro)	4.21	4.67	4.37	4.42
V_3 (Dering)	6.33	5.83	4.05	5.40
V_4 (Devon	4.88	5.34	6.09	5.44
Mean	5.41	5.49	5.17	5.36

3.2. Discussion

The result showed that the use of the P_3 technology package on the Dering variety produced the highest N content (2.86%). The increasing of application of P and K fertilizer in P_1 to P_3 technological packages in Dering variety has increased the N content in plants by 19% (increase from 2.31% to 2.81% of N content). This showed that there was a synergistic relationship between nutrient N, P and K application. Nutrient N plays a role in arranging amino acids (proteins), nucleic acids, nucleotides, and chlorophyll in plants, hence with N, plants become greener, accelerating the growth (height, number of tillers, number of branches) and increase the protein content of the crop, while in this case, P plays an important role as an ATP component which is a source of energy in fixation of nitrogen, and as a constituent component protein. K element in plants have a role very important especially in forming solutions and starch translocation, protein synthesis and improve plant tissue growth. Positive forms of interaction showed that that nutrients P and N have functions or roles that are different for plants. N nutrient functions as constituent of proteins, chlorophyll, amino acids and many other organic compounds, while P is constituent of nucleoprotein phospholipids, phosphate sugar and especially in energy transport and storage which functions and roles are mostly from these ingredients/compounds support each other and complete. This positive interaction reinforces that N availability in the soil greatly influences uptake plants against P or vice versa where availability of P on the ground will affect uptake plants against N. Nitrogen will increase root growth and development so plants are able to absorb P more effectively and besides that N is also the main constituent of the phosphatase enzyme involved in the P mineralization process on the ground (Hasanah et al, 2019a ; Hasanah et al, 2019b ; Wang et al., 2007 ; Razaq et al., 2017 ; Richardson et al., 2005 ; Homer, 2008 ; Leghari et al, 2016 ; Selvia et al, 2019). Previous researchers stated that nutrient content of plant tissue depend on environmental factors and varieties, but may also be influenced by agronomic practices. Although, the chemical composition of seeds is controlled genetically, but geographical location factors and agronomic practices also play an important role (Hasanah et al, 2019b) The N content in this study was lower than the N content of previous studies by the authors under dry land condition at Sambirejo (Langkat-Indonesia) which was 3.46% with application of 50 kg Urea/ha [19]. In this study, land that already has N content of 0.19% while the previous land has N content of 0.13%, but the use of Urea fertilizer is lower at 25 kg / ha + B. japonicum 200 g/40 kg seeds. This is due to differences in surrounding conditions with very low rainfall (170 mm/month) which allows slow N absorption. Increasing the P content of P_1 by 150 kg TSP / ha to 250 TSP / ha on P_3 increased the shoot content of P in the Anjasmoro variety showed that each variety had different respons to the application of technological package, and Anjasmoro variety is very responsive. Balemi and Negisho (2011) reported that in the absorption of P plants using various mechanisms of adaptation mechanisms to gain access to P reserves in soil that were previously unavailable such as through root morphological changes, exudation of chemical compounds into the rhizosphere roots and associations of roots with mycorrhiza. Higher efficiency of P uptake is usually associated with a larger size of root system (usually a higher root-shoot ratio) or a higher absorption rate per unit root length. This was in accordance with this research, because the interaction treatment of Anjasmoro and P_3 had a fairly low root canopy ratio compared to the others (Table 4). This indicated that Anjasmoro has a large root system in absorbing nutrients. Soybean plants have a certain capacity to absorb K nutrient. Potassium (K) has an important influence on the physiological and biochemical processes of plants. Soybeans require high available of K to achieve the optimal yield (Xuan et al, 2018). Demas, Anjasmoro and Dering varieties showed the same characteristics in K content, except Devon variety. In the three varieties, the increase in the application of 50 kg KCl/ha at P_1 to 100 kg KCl / ha in P_2 increased the shoot content of K. This showed that the three varieties have the same characteristics regarding the conversion rate of nutrients to dry matter. Apart from genetic factors, physiological changes caused by environmental conditions during the cultivation period cause changes in the efficiency of nutrient absorption (Fageria et al, 2011).

4. CONCLUSION

Each variety has a different response to the technological package that has been tested. The increasing of application of P and K fertilizer in P_1 to P_3 technological packages in Dering variety increased the N content in plants by 19%. Increasing the P content of P1 by 150 kg TSP/ha to 250 TSP/ha on P_3 increased the shoot content of P in the Anjasmoro variety by 30.33%. In Demas variety, an increase in K application to P_1 of 50 kg KCl / ha to 100 KCl / ha in P2 increased shoot content of K by 7.43%.

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