Peanut Productivity Under The Albizia Stand In Agroforestry System

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Abstract. An effort to meet the national food need is by utilizing productive forest areas under albizia stands. Food stuff such as peanuts can grow under albizia forest stands. The purpose of this research was to know success of agroforestry system implemented to tree after initial release of contract. This study was conducted under albizia stand of state forest Blitar in East Java. Research design was used in this study was randomized block design. 4-year-old albizia stages with 0%, 25%, 50% trimming intensity with plant spacing of 2 m x 3 m, 3 m x 3 m, 3 m x 4 m. Albizia trees that used for this comparison as many as 120 albizia trees. Results showed that soil lies under 4-year-old albizia trees still produced peanut with highest weights 129 g/m² and lowest weight 117 g/m² while highest biomass about 115.10 g and lowest biomass about 98.23 g. Application of agroforestry system under 4-year-old albizia stand is still good and intensive, creating work, improving social welfare, local community opinion change into positive perceptions for forestry development, forest protection, forest fire prevention, reducing rapid forest degradation and environmental quality conservation of forest areas.

1. Introduction

Food availability is very important for the security and stability of a nation. Increasing demand for food along with increasing population, will affect availability of food produced by community. An effort to meet national food demand by utilizing productive forest areas under albizia stands. Peanuts are a commodity with high economic value and can grow under albizia forest stand. Indonesia produces peanuts around 83.73% while 16.27% remaining must be imported from abroad [1]. Maintaining soil fertility can be done with usage of beans varieties as green manures are widely practiced in modern farming systems due to its ability to inhibit nitrogen, fall of leaves and stems will maintain physical properties of soil [2].

Utilization of dry land in state forest area is still not optimal, type of woody plant such albizia proved to be favorite choice by many peoples, especially Blitar district of East Java Province. In addition, albizia sale value in wood industry is quite high, albizia wood type plants proved to have been able to grow well on state forests and communities. Efforts to increase land productivity and fulfill short-term needs for community can be overcome with agroforestry technology that combines timber crops with short-cycle crops. Though, there is problem in agroforestry technology, such as interactions between plants compilers are sometimes competitive in nature with each other, over factors growth (sunlight, water and nutrients). This happens because both plants are adjacent equally require existing resources either in soil (water and nutrients) or above the ground (sunlight). Therefore, it is necessary to arrange good wood plants spacing and canopy pruning as silvicultural actions of agroforestry. The purpose of this study is to determine productivity of peanut (Arachis hypogaeae L) and growth of albizia stands on agroforestry systems in dry land state forests.
2. Materials And Methods

2.1. Time and Location
The study was conducted on below 4 year-old albizia stand in the state forest area which administratively belongs to Blitar state forest East Java region for 4 months from November 2017 to March 2018.

2.2. Materials and Research Tools
Materials needed in this research were albizia stands, peanut seeds, NPK and Urea fertilizers. Tools needed in this study are cameras, thermohydrometer, lux meters and writing tools.

2.3. Research Procedures
The research design used in the study was randomized block design. Albizia stand is 4 years old with 0%, 25%, 50% pruning intensity and a spacing of 2 m x 3 m, 3 m x 3 m, 3 m x 4 m. A number of trees were used in data preparation, which was plot tress for 30 trees to deduct edge effect where they have adequate sunlight. Plant design was been experiment trial such as agroforestry albizia. Underside stand plantation has done when plant season in first season a year, that was peanut plantation.

To know fertility of plant status was done with soil analyzes. Soil sample has taken in depth of 0-20 cm and 20-40 cm every plot. Repetition has taken from a few points then composted by one sample. Soil chemical analyze such as C degree of land organic was measured by Walkey and Black method, N totally was defined by semiautomatic Kjedhal Digestion (AOAC) method, Phosphor was measured by P. Bray and the pH of land Electrode glass method.

2.4. Data Analysis
Data collection in this study was biophysical data (physical and chemical properties of soil, temperature, humidity, and light intensity), growth of albizia (diameter and height) and growth of peanuts (peanut plant weight and dry weight of peanut pods yields). Plant growth and productivity data were analyzed quantitatively and descriptively. Data obtained by statistic analyzing shows influence from main plant growth progress and productivity. If analysis value shows positive result, it means $\alpha = 5\%$ according Duncan, this calculation is done with software SPSS ver.16 software and Microsoft excel.

| Nature of the soil          | very low | low   | medium | high   | very high |
|-----------------------------|----------|-------|--------|--------|-----------|
| N                           | <0.10    | 0.10-0.20 | 0.21-0.50 | 0.51-0.75 | >0.75     |
| $P_2O_5$HCl (me/100gr)      | <10      | 10-20 | 21-40 | 41-60  | >60       |
| $K_2$OHCl 25%(me/100gr)     | <10      | 10-20 | 21-40 | 41-60  | >60       |
| Ca(me/100gr)                | <2       | 2-5   | 6-10  | 11-20  | >20       |
| Mg(me/100gr)                | <0.4     | 0.4-1.0 | 1.1-2.0| 2.1-8.0 | >8.0      |

Source: Survey of land capability LPPT Bogor

3. Results And Discussion

3.1. Biophysical Conditions of Research Plots
Forest area used as characteristics of soil research can be seen from level description of soil fertility so that growth factors of albizia and peanut agroforestry can be identified. Based on soil samples analysis
before agroforestry planting and after agroforestry planting, it can be known characteristics of physical and chemical properties of soil at research plot location (Table 2).

Table 2. N,P,K , C Organic, soil pH under tree Agroforestry

| No. | Variabel                     | Method               | P.2 | P.3 | P.4 | P.5  |
|-----|------------------------------|----------------------|-----|-----|-----|------|
| 1   | N total (%)                  | Kjelhdal             | 0.28| 0.28| 0.22| 0.20 |
| 2   | P available (ppm)            | Bray II              | 10.63| 13.63| 7.94| 10.86|
| 3   | K confused (me%)             | Eks. Amn. Act 1N    | 0.30| 0.25| 0.16| 0.17 |
| 4   | C. organic (%)               | Walkley& Black Electrode glass | 1.08| 1.14| 0.85| 0.98 |
| 5   | pH                           | Electrode glass      | 5.17| 5.24| 5.70| 5.30 |

Source: Soil chemistry physics lab UNS agriculture faculty

Table 2 shows that soil chemical fertility on research site is categorized as low-medium. Nitrogen content and organic carbon are medium category, while phosphorus content is very low and low category. Soil pH on research location is categorized as acid soil. Nitrogen (N) and organic carbon are both in moderate condition. This is because organic matter is main source of N elements. Decomposition speed from that organic higher nutrient content and nitrogen content matter will affect N element cycle [3]. P element in acid soil will generally be bound by acid-causing elements like Al, Fe and Mn, so that elements become unavailable for plants. Albizia root growth can be inhibited due to low availability of phosphorus (P) element, especially in acid soil. Another factor that affects soil fertility is rainfall factor indicator that plants grow normally [4]. Number of rainy days in 2015-2016 was 182 with rainfall value 40,081 mm. This shows that rainfall at research site is very high. Tropical regions using quality seeds because have high temperature characteristics and high rainfall [5]. This condition causes vulnerability to soil quality because on open land will experience erosion and loss of nutrients easier due to rainwater flow. Perennial plants existence in tropical region is needed as a source of raw organic material seems to have met the standards [6].

As well as protect soil surface from rainfall. Litter Existence from perennial plants is an important source of nitrogen for non-fertilized agricultural plant mentioned that organic presence derived from plant biomass gives benefits to agricultural systems without fertilization such as: a) providing a large portion of nitrogen (N) and carbon (C) also half of phosphorus (P) to be absorbed by plants, b) Increase exchange value of soil (CEC), c) Vegetation has a large role in influencing the movement of water [7]. Assisting soil aggregate so improves soil physical properties and reduces susceptibility toward leaching on sandy soil, d) Improving ability to bind water especially to sandy soil, e) Binding micro nutrients so it prevents washing those nutrients. Interactions between species in it can produce various kinds of benefits [8].

Albizia is a type of legume that has ability to bind N in air. N accumulation in albizia biomass then provide fertility to surrounding soil through decay of upper biomass and dead plant roots. Soil fertility Increase can in the addition of organic matter to the soil and reduces the occurrence of soil damage [9]. Litter fall from albizia plants and annual plant litter biomass from albizia tree as well as waste from annual plant should be maintained its existence. Land conservation causes a decrease in run off [10].
Litter functions as a source of organic matter and also it can protect soil from mechanical damage due to rainfall and Agroforestry will reduce surface flow by 9.2% [11]. Litter existence will improve soil physical and chemical fertility. Litter loss upon harvesting will impact on increasing soil temperature by 2.5 ºC and will reduce soil moisture consequently, evaporation will increase and soil will be easily drying and losing water in soil human intervention in the ecosystem [12].

Litter is main source of nutrients after experiencing decomposition process in identifying morphological characteristics [13]. Stated that albizia leaves contain 35 g/kg N, whereas albizia root contains 13 g/kg N, moreover albizia litter can also be used as effort to overcome problem on soil with acidic ph. Albizia rooting has root nodules as a result of symbiosis with rhizobium bacteria, it is benefit to surrounding soil because it helps supply nitrogen in soil spur the decomposition and nutrient cycle processes [14].

3.2 Biomass Conditions of Research
Fertilizers treatment and their combinations did not significantly affect growth of wet pods. Based on Table 3 above, wet pods weight is larger in N1P1K1 shade with 50 g of 115.10 g. Wet pods weight of or so-called pod weights grow quite well. It has same effect on plant height. This means growth of pod weight is along with height growth of peanut crops. Food supplies in pods will also affect other growth parameters.

Fertilizers have no significant effect on wet pods weight growth statistically. However, when viewed from a farmer scale, 50 g of fertilizer can increase wet pods weight by 16.87 g to control. Main product of peanut plants is the pod, with an increase of 16.87 g for one pod, which will have a huge impact on farmers’ income if they harvest peanuts per ha table 3.

| Treatment   | Biomass average (g) |
|-------------|---------------------|
| P0K0        | 98.23               |
| P1K1        | 100.21              |
| P2K2        | 106.49              |
| P3K3        | 105.94              |
| N0P0K0      | 99.93               |
| N1P1K1      | 115.10              |
| N2P2K2      | 101.82              |
| N3P3K3      | 103.54              |

The condition of albizia stand which already has fertile soil conditions because albizia leaf litter provides a lot of organic matter to soil under its stand and albizia trees. It is included in Leguminosae tribe containing root nodules. [15] explained that rooting system of albizia contains many root nodules as a result of symbiosis with rhizobium bacteria. It is advantageous to roots and surroundings. Root nodules existence can help soil porosity and nitrogen provision in soil, thus albizia tree can make surrounding soil more fertile. Such soil conditions can be planted with nuts crops so as to increase income of share croppers.
3.3. Age and Results of Peanuts

Age of albizia used in research about 4 years and highest pruning intensity about 50%, make light intensity easy to penetrate soil influence peanut growth and production. With 50% pruning intensity, it is expected increase light intensity that can be tolerated by peanut plants for its production process. Peanuts need an open place for optimal growth. Open space without shade, is a place that optimal for peanut growth and peanut production results. Research Results in [16] showed that peanuts can grow well under albizia stands. Planting peanuts under *Acacia mangium* and *Eucaliptus deglupta* stand did not work well due to shade and roots of main plants [17]. Teak and peanut agroforestry show that in general, results obtained from agroforestry systems are lower than monocultures, both for actual and potential production [18].

![Figure 1. Peanut yield in various pruning albizia](image1)

This was due to competition in obtaining growth factors (water, nutrients and sunlight). Nonetheless, data presented in figure 1 and figure 2 shows that wider spacing result in better growth and production of peanuts in relation to age at which peanuts growth is getting older. This shows that at 4 years old albizia spacing has not given a different effect in obtaining growth factors. Differences in growth factors are more caused by treatment of pruning intensity. This is in accordance with [19] which states that tree spacing does not have a significant effect on production of peanut annual crops.

![Figure 2. Dry weight of peanuts of various distances sengon](image2)

3.4. Peanuts Growth in Agroforestry Planting Patterns

According to [20] plants that suitable for inclusion in intercropping patterns are short-type plants, small leaf crowns, not many branches, mature age and annual, resistant to pest and disease attacks, high yield and not sensitive to sunlight duration. Peanut plants have a lower canopy that can absorb
more sunlight and its plants are faster to produce. Peanuts are legume plants that can be symbiotic with Rhizobium so they are able to bind Nitrogen free in air and form root nodules can fertilize soil. According to [21] that intercropping between plants legume and non-legume is perfect because Legume plants can tie N free from air through rhizobium on its root nodules, 30% from N fixation was contributed to other plants in intercropping system. Albizia growth in agroforestry is relatively faster than pattern of albizia planting on monoculture shown by delta (higher diameter growth of lower planting). Albizia and peanuts in agroforestry pattern do not affect competition in obtaining nutrients and water from soil. This is due to different root characteristics. Existence of peanuts in agroforestry planting patterns helps adding nutrients process, especially N this because albizia growth in cropping patterns agroforestry is relatively faster than monoculture. That growth of teak diameter is better in system intercropping peanuts [22].

4. Conclusion
Albizia spacing 2 m x 3 m, 3 m x 3 m, 3 m x 4 m has not given a difference effect in obtaining growth factors. Provision of fertilizer in peanut plants has no significant effect on wet pods weight growth statistically. Albizia and peanuts in agroforestry pattern do not affect competition in obtaining nutrients and water from soil. This was due to different root characteristics

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