Gogo rice agronomic patterns on water supply variables and light intensity

Siti Aisyah¹, Chairani Hanum² and Revandy Iskandar M Damanik²

¹Student of Agrotechnology Department, Faculty of Agriculture Universitas Sumatera Utara, Jl. Prof. A. Sofyan No. 3, Medan, 20155, Indonesia
²Faculty of Agriculture Universitas Sumatera Utara, Jl. Prof. A. Sofyan No.3, Medan, 20155, Indonesia

E-mail: aisyahfendiritonga14516@gmail.com

Abstract. The study was aimed to find out the varieties of Gogo rice that are resistance of water supply and the low of light intensity and giving information about the varieties that are resistance of double water stress. The study was conducted on November 2020 to May 2021 and used a Randomized Block Design (RAK) with three factors. The first factor is soil water content of $D_1 40\%$, $D_2 60\%$, $D_3 80\%$, the second is shade intensity of $N_0 0\%$, $N_1 20\%$, $N_2 40\%$, and $N_3 60\%$. and the third is the varieties of $V_1$ Situbagendit, $V_2$ Red Sigambiri, $V_3$ Inpago 8, $V_4$ White Sigambiri. The result showed that there were differences of growing in different treatment where the highest of plant of $D_3 N_0 V_1$ is 54.73, the highest number of leaves of $D_3 N_0 V_1$ is 7.03 and the highest tillers of $D_3 N_0 V_1$ is 6.01. On each lowest observation of $D_1 N_2 V_4$, the plants died at the age of 12 mds. The findings of the study showed that the soil water content of 80\% and shade intensity of 0 % are significant effect on Gogo Varieties of Situbagendit.

1. Introduction
Rice is a C3 plant that can fix atmospheric carbon (CO$_2$) into a triple carbon intermediate in the photosynthesis process. C3 plants can experience more water loss than C4 plants such as corn and sorghum. C3 plants have a higher transpiration ratio and the stomata are always open. C3 plants undergo photorespiration which results in lower net photosynthetic yields than C4 plants. To overcome the light intensity is too high. The provision of shade is carried out on the cultivation of plants which generally belong to the C3 group as well as in the nursery phase. In group C3 plants, shade is not only needed in the seedling phase, but throughout the plant life cycle. The more mature the age of the plant, the intensity of the shade is reduced. Shade is not only needed to reduce the intensity of light that reaches the main plants, it is also used as a method of controlling weeds [1].

According to Lakitan (2000), the impact of lack of water or called drought stress on plants is that it can inhibit the rate of photosynthesis, causing stomata to close thereby inhibiting carbohydrate synthesis. In addition to water, the thing that is no less important for plants is sunlight [2]. Light is an essential factor for growth and development. Visible light (visible night), as a source of energy used by plants for photosynthesis, is part of the radiation energy spectrum. According to Lakitan (2000), light as an energy source for the anabolic reactions of photosynthesis will clearly affect the rate of photosynthesis [2].

Increased rice production can be obtained from dry land rice in the rainy season or known as upland rice. The potential for the development of upland rice cultivation is still very large because Indonesia
has lowland dry land which has the potential for the development of food crops, in this case upland rice. In dry land, the main problem encountered is the limited water source which is the result of low rainfall. This causes farmers to tend to have a low willingness to cultivate upland rice plants and switch to using their agricultural lands for cultivating crops other than food, such as plantation crops or seasonal crops. The nature and characteristics of solar radiation are related to the various components of a plant. The absorption of solar radiation by the oil palm canopy determines the nitrogen composition of the leaves. Analysis of the characteristics of solar radiation on oil palm was carried out to determine the suitability of intercrops. Solar radiation is the main source of energy used in the process of photosynthesis in the formation of carbohydrates. Based on the description, the authors are interested in conducting research on the agronomic pattern of upland rice on the variables of water supply and light intensity. The aim of this research are (1) Studying upland rice varieties that are tolerant of water supply and low light intensity, (2) Provide information on varieties that are tolerant of multiple stress and (3) Finding agronomic patterns of upland rice cultivation on land with water supply and low sunlight intensity [3–5].

2. Research methods

2.1. Research time and place
The research will be carried out on Jl. K.L. Yos Sudarso No. 43 Ex. Clove Turi Kec. North Binjai, North Sumatra with an altitude of ± 25 meters above sea level. The research will be conducted from August to November 2020.

2.2. Materials and tools
The materials used are upland rice seeds used are varieties, red sigambiri, white sigambiri, inpago 8, situbagendit and Sianggak Ukur, Topsoil, Decis, Urea fertilizer, KCL and SP36. The tools used are Polybag, white plastic, paranet, hoe, gembor, meter, analytical scale, Leaf Area Meter, Oven, Handsprayer, Bamboo, Pacak/sample. Name plate and stationery. the varieties tested came from the Center for the Assessment of Agricultural Technology in North Sumatra.

2.3. Research methods
The method used is an experimental method arranged in RAK (Randomized Block Design) with a factor one experimental design consisting of drought stress and the second factor shading stress each 3 treatments, each treatment repeated 3 times.

Factor 1: Soil Water Content (D) with 3 levels, namely:
- \( D_1 \) = Soil moisture content 40% field capacity
- \( D_2 \) = Soil Moisture Content 60% field capacity
- \( D_3 \) = Soil Moisture Content 80% field capacity

Factor 2: Shade Intensity (N) with 4 levels, namely:
- \( N_0 \) = No Shade 0%
- \( N_1 \) = Shade 20%
- \( N_2 \) = Shade 40%
- \( N_3 \) = Shade 60%

Factor 3: Varieties (V) Upland Rice, namely:
- \( V_1 \) = Red Sigambiri
- \( V_2 \) = White Sigambiri
- \( V_3 \) = Situbagendit
- \( V_4 \) = Stand Measure
- \( V_5 \) = Inpago 8
plant height values showed that the genotype treatments were significantly different, the shade level showed changes in genotypes of upland rice under shade stress at the age of 13 WAP. The results of statistical analysis was carried out using a Factorial Randomized Block Design (RAK) with the following mathematical model:

\[ Y_{ijkl} = J + Ki + Lj + Mk + (LM)_{jk} + Nijk \]  

Yijkl = Observation results  
J = General average of observation values  
Ki = Effect of repetition at level i  
Lj = Effect of stopping watering treatment level - j  
Mk = Effect of varietal treatment level  
Oijk = Effect of error on i-level replication, j-level watering treatment, k-th shade

The data obtained were statistically tested with variance and further tests for real treatments using Duncan's Multiple Range Test (DMRT) at a 5% significance level.

3. Results and discussion

3.1. Morphological characters plant length. The results of analysis of plant length variance from 5 genotypes of upland rice under shade stress at the age of 13 WAP. The results of statistical analysis showed that the genotype treatments were significantly different, the shade level showed changes in plant height values (Table 1).
### Table 1. Plant length of five genotypes of upland rice with drought stress and shade levels

| Varieties         | Drought Stress (%KL) | Shade 0% (cm) | Shade 20% (cm) | Shade 40% (cm) | Shade 60% (cm) | Average     |
|-------------------|----------------------|---------------|---------------|---------------|---------------|-------------|
| Inpago 8          | 40%                  | 88.02         | 76.17         | 70.63         | 52.48         | 71.83       |
|                   | 60%                  | 99.17         | 90.17         | 86.17         | 76.30         | 87.95       |
|                   | 80%                  | 115.22        | 113.2         | 96.00         | 64.22         | 71.87       |
| Sigambiri Merah   | 40%                  | 80.02         | 78.07         | 76.43         | 57.47         | 73.00       |
|                   | 60%                  | 87.82         | 80.07         | 78.43         | 47.47         | 73.45       |
|                   | 80%                  | 92.15         | 90.38         | 84.40         | 54.45         | 80.35       |
| Sigambiri Putih   | 40%                  | 80.82         | 78.01         | 76.43         | 52.47         | 71.93       |
|                   | 60%                  | 77.82         | 75.07         | 68.43         | 50.07         | 67.85       |
|                   | 80%                  | 87.82         | 101.0         | 88.43         | 57.47         | 83.70       |
| Situbagendit      | 40%                  | 84.28         | 97.17         | 73.10         | 52.33         | 76.72       |
|                   | 60%                  | 86.48         | 99.87         | 76.10         | 60.53         | 80.75       |
|                   | 80%                  | 88.58         | 101.8         | 79.10         | 62.53         | 83.02       |
| Sianggak Ukur     | 40%                  | 76.48         | 70.87         | 60.10         | 40.53         | 62.00       |
|                   | 60%                  | 79.58         | 74.87         | 74.10         | 43.53         | 68.02       |
|                   | 80%                  | 78.58         | 72.87         | 70.10         | 42.53         | 66.02       |

**Note:** The numbers followed by different notations in the same row or column show a significant difference in DMRT at the 5% level.

Each genotype has a different response to plant length. If sorted genotypes from highest to lowest plant length are as follows: Inpago 8, red Sigambiri, white Sigambiri, Situ bagendit and Sianggakukur. The highest average length of upland rice plants was at 0% shade and the lowest was at 60%. There was an increase in plant length by 3.04% when the shade was increased from 0% to 20%, but if the stress continued to be increased from 40% and 60% plant length was no longer increasing.

### 3.2. Number of tillers.
Genotype treatment, shading and their interaction significantly affected the number of upland rice tillers aged 13 WAP. The results of the analysis of variance in the number of upland rice tillers aged 13 WAP (Table 2).

### Table 2. The number of tillers of five genotypes of upland rice with drought and shade levels

| Varieties         | Drought Stress (%KL) | Shade 0% | Shade 20% | Shade 40% | Shade 60% | Average |
|-------------------|----------------------|----------|-----------|-----------|-----------|---------|
| Inpago 8          | 40%                  | 8.02     | 0.17      | 0.03      | 0.00      | 2.06    |
|                   | 60%                  | 10.17    | 0.17      | 0.17      | 0.00      | 2.63    |
|                   | 80%                  | 14.17    | 1.83      | 0.50      | 0.00      | 4.13    |
| Sigambiri Merah   | 40%                  | 18.02    | 2.17      | 0.43      | 0.00      | 5.16    |
|                   | 60%                  | 20.02    | 3.77      | 1.43      | 0.00      | 6.31    |
|                   | 80%                  | 23.83    | 4.50      | 1.50      | 0.00      | 7.46    |
| Sigambiri Putih   | 40%                  | 18.82    | 1.01      | 0.43      | 0.00      | 5.07    |
|                   | 60%                  | 20.82    | 2.07      | 0.43      | 0.00      | 5.83    |
|                   | 80%                  | 22.50    | 3.83      | 0.83      | 0.00      | 6.79    |
observing plant the Inpago 8 variety at 80% field capacity and 40% shade stress was the best for the parameters for
From the results of research observations that have been carried out the growth of upland rice plants of
4.
3.3. Flag leaf area. Based on analysis of variance, it showed that the treatment of water content, field
capacity and shade, genotype and their interaction affected the area of the flag leaf. The average leaf area
of the flag can be seen in Table 3.

Table 3. Flag leaf area of five genotypes of upland rice with drought and shade levels

| Varieties         | Drought Stress |         |         |         |         |         |
|-------------------|----------------|---------|---------|---------|---------|---------|
|                   |                | 0%      | 20%     | 40%     | 60%     | Average |
| Situbagendit      | 40%            | 14.28   | 2.17    | 0.91    | 0.13    | 4.37    |
|                   | 60%            | 16.48   | 3.00    | 1.10    | 0.53    | 5.28    |
|                   | 80%            | 19.83   | 3.17    | 1.33    | 0.67    | 6.25    |
| Sianggak Ukur     | 40%            | 14.28   | 1.17    | 0.51    | 0.00    | 3.99    |
|                   | 60%            | 16.48   | 2.00    | 0.87    | 0.00    | 4.84    |
|                   | 80%            | 16.83   | 2.17    | 1.00    | 0.00    | 4.46    |

Note: The numbers followed by different notations in the same row or column show a significant
difference in DMRT at the 5% level.

If grouped based on the average, the number of upland rice tillers at 0% can be obtained the same
nine groups: 1) White sigambiri and red sigambiri; 2) Situ bagendit; 3) Inpago 8, 4) measure nod. The
number of upland rice tillers decreased with increasing shade level, the size of the decrease depending
on the type of genotype. There was a decrease in the number of tillers at the 20%, 40% and 60% shade
levels, respectively 2.23%, 0.19% and 0.1% compared to the 0% shade treatment.

3.3. Flag leaf area. Based on analysis of variance, it showed that the treatment of water content, field
capacity and shade, genotype and their interaction affected the area of the flag leaf. The average leaf area
of the flag can be seen in Table 3.

Table 3. Flag leaf area of five genotypes of upland rice with drought and shade levels

| Varieties         | Drought Stress |         |         |         |         |         |
|-------------------|----------------|---------|---------|---------|---------|---------|
|                   |                | 0%      | 20%     | 40%     | 60%     | Average |
|                   |                |         |         |         |         |         |
| Inpago 8          | 40%            | 38.02   | 79.07   | 29.13   | 15.00   | 40.31   |
|                   | 60%            | 40.17   | 80.17   | 30.17   | 16.81   | 41.83   |
|                   | 80%            | 42.21   | 82.57   | 32.29   | 18.92   | 44.00   |
| Sigambiri         | 40%            | 48.02   | 49.17   | 32.43   | 16.42   | 36.51   |
| Merah             | 60%            | 50.22   | 53.77   | 35.43   | 17.00   | 39.06   |
|                   | 80%            | 51.84   | 55.73   | 37.41   | 18.78   | 40.94   |
| Sigambiri Putih   | 40%            | 46.02   | 49.17   | 30.43   | 14.42   | 35.01   |
|                   | 60%            | 47.02   | 50.77   | 33.43   | 16.00   | 36.81   |
|                   | 80%            | 49.84   | 51.73   | 35.41   | 17.78   | 38.69   |
| Situbagendit      | 40%            | 40.28   | 50.17   | 29.91   | 14.13   | 33.62   |
|                   | 60%            | 42.48   | 54.00   | 31.10   | 16.53   | 36.03   |
|                   | 80%            | 44.94   | 57.60   | 34.59   | 19.53   | 39.17   |
| Sianggak Ukur     | 40%            | 40.28   | 50.17   | 29.91   | 14.13   | 33.62   |
|                   | 60%            | 42.48   | 54.00   | 31.10   | 16.53   | 36.03   |
|                   | 80%            | 44.94   | 57.60   | 34.59   | 19.53   | 39.17   |

Note: The numbers followed by different notations in the same row or column show a significant
difference in DMRT at the 5% level.

Flag leaf area increased with increasing shade level up to 20% in all genotypes. Meanwhile, at 40% and
65% shade, the flag leaf area continued to decrease with increasing shade levels for all genotypes
compared to 20% shade.

4. Conclusion
From the results of research observations that have been carried out the growth of upland rice plants of
the Inpago 8 variety at 80% field capacity and 40% shade stress was the best for the parameters for
observing plant height, leaf number and flag leaf area, and the worst growth was in the order of white
sigambiri, red sigambiri and situbagendit varieties. two varieties of white and red sigambiri died at 10
mst. The effect of water availability on plant growth is very large. Lack of water in plants followed by reduced water in the root area results in plant physiological activities. The mechanism that occurs in plants experiencing water stress is to develop a response mechanism to drought. The response of rice plants to drought stress begins with a physiological response in the form of a transpiration rate to save water by closing stomata and reducing leaf surface area by leaf rolling.

References
[1] Priyatno T P 2012 Pengembangan padi C4 strategi inovasi adaptif menghadapi pemanasan global Balai Besar Penelit. dan Pengemb. Bioteknol. dan Sumberd. Genet. Pertan. 9–12
[2] Lakitan B 2000 Dasar-dasar Fisiologi Tumbuhan (Jakarta: PT Raja Grafindo Persada)
[3] Sujinah S and Jamil A 2016 Mekanisme Respon Tanaman Padi Terhadap Cekaman Kekeringan dan Varietas Toleran Iptek Tanam. Pangan 11 1–8
[4] Sari I R N, Purwanto E and Pardono 2015 Kajian Ketahanan Terhadap Cekaman Air Pada Padi Hitam dan Padi Merah urnal pasca UNS El-Vivo 3 25–33
[5] DH T A, Suwarto S, Riyanto A, Susanti D, Kantun I N and Suwarno S 2011 Pengaruh Waktu Tanam dan Genotipe Padi Gogo terhadap Hasil Penelit. Pertan. Tanam. Pangan 30 17–22