



ADAPTATION OF FOUR STRAWBERRY VARIETIES AT A LAND ALTITUDE OF 900 METERS ASL WITH DIFFERENT SHADE

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ARTICLE INFO	ABSTRACT	
Article history	<i>Strawberries are herbaceous plants originating from sub-tropical regions. In Indonesia, which has a tropical climate, Strawberries can adapt well to the highlands of more than 1000 meters above sea level. At present, not much is known about strawberry varieties that are able to adapt to the plains below 1000 m asl, so it is necessary to do research to find strawberry varieties that are able to adapt to the plains below 1000 masl. This research was conducted on agricultural land at an altitude of 900 m asl in the Ngesrebalong Village area, Limbangan District, Kendal Regency from September to October 2022. The research design used was a Completely Randomized Design with different types of shading. The treatment used is shading in the form of 50% paranet and 70% paranet. Data were analyzed statistically with ANOVA and descriptive qualitative analysis. Four varieties of strawberries (California, Mencir, Merlan and Sagahonoka) have different acclimatization adaptation abilities at an altitude of 900 meters above sea level. Providing shade with paranet 50% and 70% can increase the acclimatization ability of Strawberries. Mencir and Sagahonoka varieties are Strawberry varieties with the highest acclimatization adaptability and are very suitable for cultivation at an altitude of 900 meters above sea level.</i>	
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INTRODUCTION

Strawberry (*Fragaria* spp.) is a fruit plant with high economic value. Fresh red strawberries, tiny in size with a sweet and sour taste make strawberries a fruit that is very attractive to consumers. Strawberries can be consumed fresh or processed into

processed products such as jams, sweets, syrup, lunkhead, yogurt, ice cream, and as a food complement. Strawberries are known to be able to improve heart health because they have a low-fat value, and contain high levels of vitamin C, folic acid, potassium and antioxidants (Kurnia, 2005; Budiman and Saraswati, 2008).

Strawberry is a herbaceous plant, first discovered in Chile, America with a sub-tropical climate. In tropical climates, strawberries can adapt well to highlands of more than 1000 meters above sea level with temperatures of 17-20⁰C, rainfall 600-700 mm/year, humidity 80-90% and long exposure to sunlight 8-10 hours per day (Ashari, 1995; Hanifand Azhari, 2012).

In Indonesia, which is a tropical country, many strawberry plants are cultivated conventionally by farmers in the highlands such as in Lembang, Ciwidey, Cianjur, Sukabumi, and Brastagi which are at an altitude of more than 1000 m above sea level (asl). However, strawberry production in Indonesia has decreased every year. The decline in strawberry production is partly due to the very limited availability of land in the highlands for cultivation and has even begun to decrease (Badan Pusat Statistik Republik Indonesia, 2015). Land conversion as a tourism route, increasing population, and erosion are the causes of reduced land for strawberry cultivation. Therefore, it is necessary to cultivate strawberries on medium plains by adapting them to cultivated lands that are on lower plains.

Currently, not much is known about strawberry varieties that are able to adapt to the plains below 1000 meters above sea level. Therefore, it is necessary to conduct research to find strawberry varieties that are able to adapt to the plains below 1000 meters above sea level. The purpose of this study was to determine the acclimatization adaptability of several varieties of Strawberries at an altitude of 900 meters above sea level in Ngesrep Balong Village, Limbangan District, Kendal Regency.

This research is expected to be useful as basic data in efforts to cultivate strawberries in Ngesrep Balong Village, Limbangan District, Kendal Regency, and can be used by related parties, especially in efforts to cultivate strawberries. In addition to these benefits, it is hoped that the results of this research can add insight to the residents of Ngesrep Balong Village regarding strawberry cultivation around them and provide insight into how to cultivate these strawberries. This research can also provide scientific

information about the acclimatization ability of Strawberries planted at an altitude of 900 meters above sea level in Ngesrep Balong Village, Limbangan District, Kendal Regency.

MATERIALS AND METHODS

Location and Time of Research

The research was conducted on agricultural land at an altitude of 900 meters above sea level in the Ngesrepbalong Village, Limbangan District, Kendal Regency. The study was conducted on a small scale and was carried out for three months. Strawberry planting was carried out in September 2022. Measurement of environmental factors and data collection on the results of Strawberry acclimatization adaptation was carried out from September to October 2022.

Research Design

The research design used was a Completely Randomized Design with different treatment of shade. The shade used is paranet. The treatment was paranet 50% (P1), 70% (P2) and without shade as a control (P0). The coding for each treatment level is as follows. Each level of treatment was repeated 3 times, so that there were 9 experimental units for each strawberry variety.

Research Variable

Independent variable: paranet density as shading.

Dependent variable: number of live individuals (percent survival) of each strawberry variety during the acclimatization adaptation process, shape and size of stems, leaves, flowers and fruit.

Research Tools and Materials

Tools and materials used include Strawberry Plant, Paranet 50%, Paranet 70%, Hoe, Camera, Altimeter, Thermometer, Hygrometer, and Lux meter

Data Retrieval Method

Data were collected and obtained by measuring or observing directly at the research site, which includes the number of individuals alive during the acclimatization adaptation process, the shape and size of stems, leaves, flowers and fruit. Field data collection in this

study was carried out by observing various varieties of strawberries (California, Mencir, Merlan and Sagahonoka), direct measurement of the ecological environmental conditions of strawberries, and collecting data on strawberry varieties and the number of strawberry plants that were successful in acclimatization adaptation. Primary data in the form of a map of the research location and environmental status of Ngesrepbalong village.

Research Procedure

Field survey

The field survey activity was carried out as a preliminary study to get a general picture of the condition of agricultural land in Ngesrepbalong Village, Limbangan District, Kendal Regency, will be used as a research site. The location for planting strawberries is determined on agricultural land with an altitude of 900 meters above sea level.

Preparation, planting and acclimatization

Preparation of land for planting strawberries in a predetermined location. Land preparation by making beds measuring 150 cm x 300 cm with a height of 30 cm. Strawberry planting is carried out on beds that have been made with a distance of 50 cm between plants. Strawberry treatment is done daily and weekly. Daily maintenance includes watering the strawberries to maintain moisture, checking for pests and diseases. Weekly maintenance is carried out by alternately administering fertilizers and fungicides. Data collection on the acclimatization ability of strawberries was carried out by observing the number of individual strawberries that were able to survive and the number of individuals that died. This observation was carried out for 21 days.

Analysis Data

Data analysis on the acclimatization adaptability of strawberries was carried out in the following way.

$$\text{Acclimatization ability} = \frac{\text{Number of surviving individuals}}{\text{Number of planted individuals}} * 100\%$$

Furthermore, the adaptive capacity data was analyzed using ANOVA and if there was a significant difference, it was continued with the BNT Test. Analysis of changes in the properties that occur in strawberries due to acclimatization adaptation in Ngesrep Balong Village, Limbangan District, Kendal Regency was carried out in a descriptive qualitative manner by describing in detail the changes in properties that occur in strawberries due to

acclimatization. Analysis of strawberry varieties suitable for conservation in Ngesrep Balong Village, Limbangan District, Kendal Regency was carried out in a qualitative descriptive manner.

RESULTS AND DISCUSSION

The environmental conditions for planting strawberries in Ngesrepbalong Village, Limbangan District, Kendal Regency are based on measurements of altitude, light intensity, air temperature, and complete humidity presented in **Table 1**.

Table 1. Results of Physical Data Measurement of Environmental Conditions and Observation of Stomata Characteristics of Pigeon Orchids during the Research

Shade	Light Intensity (Lux)	Temperature (⁰ C)	Air Humidity (%)
Without Shade	1.419 – 1.985	25 – 27	80 – 90
Paranet 50%	1.140 – 1.374	23 – 25	85 – 95
Paranet 70%	885 – 1.196	21 – 22	85 – 95

Table 1 shows that the environmental conditions where the strawberries are planted in Ngesrepbalong Village, Limbangan District, Kendal Regency, based on light intensity, air temperature, and air humidity during the day, are classified as environments with moderate light intensity and air temperature, with high air humidity (Sopandie, 2013). The table also shows that providing 50% and 70% paranet shading can reduce light intensity, air temperature, and increase air humidity. This is in accordance with the opinion Sopandie (2013) which states that shade can regulate incoming sunlight, reduce temperature, and create an ideal microclimate for plant growth.

Strawberry varieties that were planted after 21 days in various environmental conditions showed different conditions. Some plants died, some stagnant did not die but also showed no growth, and some showed growth. In full, the condition of each Strawberry variety at 21 days is presented in **Tables 2**.

Table 2. Plant condition of four varieties strawberries at 21 days

No.	Plant Condition	Variety	Number of Plant		
			Without Shade	Paranet 50%	Paranet 70%
1	Dead	California	5	2	2
		Mencir	4	1	1
		Merlan	7	3	2
		Sagahonoka	4	2	1
2	Stagnant	California	6	3	2
		Mencir	6	3	3

No.	Plant Condition	Variety	Number of Plant		
			Without Shade	Paranet 50%	Paranet 70%
3	Alive	Merlan	5	4	3
		Sagahonoka	3	3	3
		California	4	10	11
		Mencir	5	11	11
		Merlan	3	8	10
		Sagahonoka	8	10	11

Tables 2 show that each strawberry variety has a different acclimatization ability to adapt to different environmental conditions. This is due to genetic differences between strawberry varieties. Pramono (2009) states that differences in the response of each plant to environmental factors are caused by genetic differences in each plant. Salisbury and Ross (1995) also states that each species and often each cultivar or variety shows and responds differently to different environmental factors.

Strawberry plants adapt to low light intensity so shading is intended to reduce the intensity of light reaching the plants. Temperature due to solar radiation affects the rate of plant transpiration. Excessive increase in temperature will disrupt plant metabolism so that the use of shade can reduce transpiration and can maintain water balance (Lakitan, 2012). Shade will affect the processes in the plant, lowering the dark respiration, saturation point and light compensation point (Fitter and Hay, 1992).

The acclimatization adaptability of each Strawberry variety can also be seen based on the survival percentage of the individuals planted. Handriawan et al. (2016) stated that the success of the adaptability of a plant can be known through the success criteria of the percent of plant life. Percent survival is the percent chance of survival of the provenance, and the length of time the provenance can survive. The survival percentage of each Strawberry variety planted after 21 days at various environmental conditions is presented in **Table 3**.

Table 3. Adaptability of acclimatization of each strawberry variety based on percent living at 21days

No.	Strawberry Varieties	Acclimatization adaptability (%)		
		Without Shade	Paranet 50%	Paranet 70%
1.	California	67 ^b	87 ^{ab}	87 ^a
2.	Mencir	73 ^b	93 ^b	93 ^a
3.	Merlan	53 ^a	80 ^a	87 ^a
4.	Sagahonoka	73 ^b	87 ^{ab}	93 ^a

Note: numbers followed by the same letter in the same column show no significant difference according to ANOVA test at 5%.

Based on **Table 3**, the acclimatization ability of the strawberries planted in Ngesrep Balong Village is classified as medium to high, ranged from 53 - 93%. The highest acclimatization adaptability was found in the Mencir and Sagahonoka varieties which were planted with 70% paranet shade, namely 93%. Table 3 also shows that the acclimatization ability of strawberries planted in the open is relatively low, which ranges from 53 – 73%. This is in accordance with the statement Herisva (2016) that in the low lands, shade treatment can increase the growth of strawberries, while strawberries in the open will inhibit its growth.

Strawberries planted under paranet shade increased 50% and 70% of their acclimatization ability, namely between 80 – 93% and 87 – 93%, respectively. The increase in the acclimatization ability of strawberries under shade is due to the fact that shade can create suitable environmental conditions for strawberry growth. Providing shade can reduce air temperature and increase air humidity (Yulianti et al. 2007). Shade in the form of 50% and 70% paranet can effectively reduce the light intensity and air temperature received by the strawberries (Harjanto and Rahmania 2007).

Providing shade for strawberries grown in the lowlands can significantly increase the growth and number of fruits. Providing 50% shade can increase vegetative growth, while 75% shade can increase the number of strawberries (Bahri et al., 2017). Strawberries that are planted without shade will experience growth disturbances due to the influence of temperatures that are above the optimum temperature (Salisbury and Ross, 1995; Herisva, 2016). In general, strawberries like relatively low air temperatures and not too strong sunlight (Kesumawati et al., 2012).

The percentage of plant life planted in a certain area indicates whether or not the plant is suitable for growing and developing in that area. The suitability level of Strawberry varieties for cultivation in Ngesrep Balong Village, Limbangan District, Kendal Regency is presented in **Table 4**.

Table 4. Level of Suitability of Strawberry varieties for cultivation

No.	Strawberry Varieties	Acclimatization Adaptability		
		Without Shade	Paranet 50%	Paranet 70%
1.	California	Quite appropriate	Quite appropriate	Quite appropriate
2.	Mencir	In accordance	In accordance	In accordance
3.	Merlan	In accordance	In accordance	In accordance
4.	Sagahonoka	In accordance	In accordance	In accordance

Abdurachman (2016) stated that he said the value of percent survival, gives an indication that a plant is suitable for growing in that habitat. By looking at the survival percentage of each Strawberry variety in Tables 3 and 4, the four Strawberry varieties above are all suitable (California variety) and very suitable (Mencir, Merlan, Sagahonoka varieties) for cultivation in Ngesrep Balong Village, Limbangan Subdistrict, Kendal Regency with 50% - 70% paranet shade.

Adaptation is an effort to adapt living things to the changes that occur in their environment. This adaptation can be in the form of morphological, physiological, behavioral adaptations, or intra-community relations. Haryanti, et al (2009) states that the adaptation made by plants to environmental changes is a special engineering of morphological and physiological characteristics so as to provide opportunities for success in adaptation. Adaptability is influenced by plant species. Different types of plants will show different adaptability to environmental changes.

CONCLUSION

Four varieties of strawberries (California, Mencir, Merlan and Sagahonoka) have different acclimatization adaptation abilities at an altitude of 900 meters above sea level. Providing shade with paranet 50% and 70% can increase the acclimatization ability of Strawberries. Mencir and Sagahonoka varieties are Strawberry varieties with the highest acclimatization adaptability and are very suitable for cultivation at an altitude of 900 meters above sea level.

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