Salt Salinity Tolerance on Nursery of _Indigofera zollingeriana_

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Abstract: _Indigofera zollingeriana_, is a legume plant that has a high protein content and is very potential to develop as one of the forage crops. This study was conducted to determine the tolerance level of _Indigofera zollingeriana_, concerning to the level of NaCl concentration in cultivation seedlings as an effort to develop these forages on a marginal land, especially on saline land, so that the potential of saline land can be utilized properly. This study used a randomized block design with 3 groups and 5 replications, maintained and observed intensively for 30 days. The first treatment (P1) was grown on soil and compost media (1:1) and given a water without NaCl concentration. The second treatment (P2) was grown on soil, sand and compost media (1:1:1) and given a water with a concentration NaCl of 50 mM/2.925 g/ l, and the third treatment (P3) was grown on soil, sand and compost media (1:1:1) and given a water with a concentration NaCl 100 mM/5.85 g/ l. The results showed that _Indigofera zollingeriana_ growth and develop on medium on the salinity of 9.9 indicated that the plant's tolerance high salinity levels despite the effect of salt stress affecting growth plant.

Keywords: _Indigofera zollingeriana_, Legume, Salinity, NaCl, Forages

1. Introduction
Forage feed is the main source of feed for ruminant livestock with daily consumption reaches 70% of the total ration and plays a very important role because forage contains almost all the necessary substances for livestock. The presence of fiber in forage feeds such as cellulose and hemicellulose is a source of energy for rumen microbes, as well as minerals and proteins, especially those derived from leguminous as the source of N for rumen bacteria.

Legume has been known to have potential as a source of high-quality feed, especially during the dry season when the availability of forage grass declined sharply. Forage quality is reflected in the nutritional value contained in it. Forage generally contains crude protein, fat, crude fiber, and minerals. Crude protein is a very important nutrient for livestock. Forage that contains high crude protein is owned by most leguminous plants.

One type of leguminous plant that has not been explored much is _Indigofera zollingeriana_, The crude protein content and crude fat of _Indigofera sp._, Were high, ie 24.2% and 6.2% respectively. With a high enough protein content, relatively low fiber content and high levels of digestibility, _Indigofera sp._, Is potentially used as a source of forage and as a source of protein supplement feed [1].

In order to provide forage feed for sustainable livestock feed is needed that is tolerant of various environmental stress conditions. Amongst a variety of environmental stresses, salinity is one of the most common stresses [2]. Less fertile land use such as saline for feed crops is a very important alternative to deal with the declining productive lands that convert to residential functions. The use of saline also has great potential because Indonesia is an archipelagic country with long coastline dominated by saline field. [3] Land in Indonesia about 181.000 km2 located along the beach and has
not been utilized. Strategies to deal with these marginal land issues agronomically can be done by utilizing plant cultivars that are tolerant to salinity stress [4]

Efforts to use cultivars of salinity tolerant food plants to date are still constrained by the limited availability of salinity tolerant plant feed cultivars. The problems of infertility of the land also need to be overcome by creating cultivars of feed plants that are tolerant to salinity by making alternative methods of testing fast and easy before direct planting to the field. *Indigofera zollingeriana*, ones of forage animal feed that has tolerance to dry soil conditions [1]. *Indigofera zollingeriana*, still able to survive and produce at the level of severe drought stress (25% field capacity), despite decreasing productivity. With the ability of *Indigofera zollingeriana*, To survive in drought conditions, it is expected that *Indigofera* sp., Also able to survive in salinity condition, because the effect of drought stress is almost the same as salinity stress [5]

This study aimed to determine the tolerance level of salinity of *Indigofera zollingeriana*, In the nursery which is expected to be the base of *Indigofera zollingeriana*. Plant development, on marginal land especially on the saline field, so that potential of *Indigofera zollingeriana*, As forage feed and also the availability of saline area wide enough to be put to good use.

2. Method

The study was conducted at the experimental farm of Animal Science Faculty, Hasanuddin University, Makassar, Indonesia. At first, 12-d old seedlings were used for germination. The seeds were planted in the pot using medium compost: soil (1:1) until cotyledone leaves change to complete 2-3 leaves. Germinated seeds were transferred to poly-bag contain medium sand: soil: compost (1:1:1), each treatment contains 2 poly-bags. The study designed by Randomized Block Design with 3 treatment and 5 groups. The treatments were: P1 = water without NaCl control); P2 = water + NaCl concentration of 50 mM (2.925 g/l); P3 = water + NaCl concentration of 100 mM (5.85 g/l).

This experiment has been carried out in a randomized block design with 3 treatment and 5 blocks per treatment. Statistical significance between mean values was assessed using the analysis of variance and conventional Duncan’s multiple range tests using SPSS Statistical version 17.0 software. A probability of p<0.05 was considered significant. The data obtained were analyzed by Variance (ANOVA).

3. Results

3.1. Measurement of Soil Salinity

Based on the result of soil analysis from Soil Chemistry and Soil Fertility, Faculty of Agriculture, Department of Soil Science, Hasanuddin University, as a medium of treatment of legumes of *Indigofera zollingeriana* describe in Table 1.

| No. | Treatments | Salinity level (dS/s) Extract 1:2,5 |
|-----|------------|-----------------------------------|
| 1   | P1         | 0,54                              |
| 2   | P2         | 1,14                              |
| 3   | P3         | 9,99                              |

**Description:** P1 (Without addition of NaCl), P2 (Addition of NaCl 50 mM / 2.925 g / litre of water), P3 (Added NaCl 100 mM / 5.85 g / litre water)

3.2. Morphology *Indigofera zollingeriana*

Morphology of plants can also show the effect of treatments on *Indigofera* sp. that can appear from the shape, color, and response of plants. More specifically, the morphology of *Indigofera* sp. in each treatment can be seen in figure 1.
4. Discussion

Based on soil analysis results it can be seen that in the treatment of P1 (without addition of NaCl) the salinity rate of the media is 0.54, then at the treatment of P2 (Addition of NaCl 50 mM / 2,925 g / litre of water) the salinity level of 1.14 and P3 (NaCl addition of 100 mM / 5.85 g / litre of water) of media salinity level of 9.99. At treatment P3 with salinity level 9.99 classified as level with high salinity. This is consistent with the opinion [7] that salinity levels of 8-16 include high salinity levels and only for high tolerant plants. This indicates that the legumes of tilapia (Indigofera sp.) can survive with a high salinity level of 9.99 although it provides a salt stress effect with changes in plant height, leaf number, leaf area and leaf area index.

Reduced rate and quality of Indigofera sp. Growth in saline conditions can be due to the decreased potential of water from the substrate where it grows, increased absorption of Na and Cl, or both. The effects of water loss on plant tissue will decrease cell turgor, increase the macroeconomic concentration of molecules as well as compounds with low molecular weight, affect the cell membrane and the potential chemical activity of water in plants. It is supported by [8] that the role of water is very important for plants which can have consequences that directly or indirectly the water shortage in plants will affect all of its metabolic processes so as to decrease plant growth. Salinity causes a further effect on plant growth because it can reduce the potential of groundwater which further causes osmotic stress, affect the imbalances of ions in the cell, in particular, decreases the concentration of K⁺, Ca²⁺, and NO₃⁻ ions, and causes the poisoning of Na⁺ and Cl⁻. The disruption of plant growth occurs due to inhibition by both Na⁺ and Cl⁻, where Na⁺ is the main causative agent that damages plant growth [9].

Potential soil saline osmotic soil solution is similar to that caused by drought (dry), then some symptoms due to salt stress are also seen in plants that experience drought causing barriers to the process of plant growth [10]. Based on research [11] the effect of salinity stress on rice crops is the decrease in plant height and number of tillers, root growth is inhibited, the weight loss of 1000 grains and the total protein content in the seeds due to excessive Na absorption, and reduced dry weight of the plant. [12] also reported that the high growth rates of rice and wheat crops decreased differently with increasing NaCl concentrations in plant growth mediums.

The main effect of salinity is the decrease in leaf growth which directly leads to reduced plant photosynthesis. It is supported by [10] that in saline conditions, growth and development of plants are
inhibited due to excessive accumulation of Na and Cl in the cytoplasm, causing metabolic changes in the cells. Enzyme activity is also hampered by salt.

This is in accordance with the study [13] which states that the salinity level will affect the number of leaves from Rhizophora stylosa seedlings and Avicennia marina where the higher the salinity, the less number of leaves produced. NaCl salt can inhibit the balance of growth hormone. The addition of NaCl may increase ABA while the concentration of auxin, gibberellin, and cytokinin decreases dramatically. Therefore, the formation of new leaves will be inhibited by the decrease of cytokines and gibberelmins that play a role in cell division and growth [14].

The decrease in total leaf area is the response of plants to the water supply. The response of the plants to the water supply is suspected because the leaf cells are still young and are holding a water stress experienced by salinity. This situation causes the enlargement and elongation of young cells that are not maximal plastic. When the cells become mature and the cell wall is not plastic anymore due to lignification, the leaf cell size remains small, this causes the leaf area becomes narrow. That the total leaf area is the most affected variable compared to other growth parameters, which can be judging by the drastic decline of leaf area indicating that high sensitivity of leaf growth to salinity [15].

Further explains that the reduction in leaf growth rate is a form of salt stress adaptation because increased soil salt levels inhibit the absorption of water by plants and to limit leaf transpiration. Smaller leaf sizes are essential for maintaining turgor [16]. While root lignification is necessary for the adjustment of osmosis which is essential for maintaining the necessary turgor for plant growth and normal activity. Reduced leaf area will affect photosynthesis. The area of the leaf plays an important role, as the rate of photosynthesis takes place following the broad development of the leaf [17].

Based on research [18] the broad growth of leaves of green mustard greens has been effected at salt treatment concentrations of 4000 ppm - 10,000 ppm. This condition is caused by the presence of excess salt that inhibits the process of cell division. According to [19], one of the negative effects of salt on the plant can be a decrease in the ability of plants to absorb water so that it affects the process of cell division and affect hormonal function. Excess salt may decrease the function of the hormone auxin. [20] Auxins play a role in spurring cell division and enlargement [21].

Salinity causes structural changes that improve the water balance of the plant so that the water potential in the plant can maintain turgor and all biochemical processes for normal growth and activity. Structural changes include smaller leaf sizes, smaller stomata per unit of leaf area, increased suction, cuticle thickness and wax coating on the leaf surface, and earlier root lignification [17].

Some researchers consider the reduction of cell size in stress conditions as an adaptation mechanism of extreme environmental conditions. Reduced cell size appears to be the primary responsibility of cells to water deficiency caused by drought or salt stress. The status of water is very sensitive to salinity and therefore greatly determines the response of plants to stress.

5. Conclusion

Adaptability of *Indigofera zollingeriana* growth on medium NaCl indicates these plants very tolerance to salt salinity with high salinity levels despite the effect of salt stress affecting plant growth, therefore these species potential developing forages in the coastal land.

6. Acknowledgment

This research was supported/partially supported by the University of Hasanuddin and The Ministry of Higher Education and Research Technology, as supporting institution who provided insight and expertise that greatly assisted the research. We would also like to show our gratitude to the researcher for sharing and working their pearls of wisdom during this research. We are also
immensely grateful to Forum Dosen Indonesia (FDI) for their comments on an earlier version of the manuscript.

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