Growth and yield responses of forage sorghum ratoon to different inorganic fertilizers

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Abstract. The purpose of this study was to determine effect of the level of NPK fertilizers on the growth and yield of sweet sorghum forage. Experiment was arranged in a completely randomized design consisting of five treatments and three replications. Each treatment was given a dose of NPK fertilizers (16:16:16) with different doses. The treatments were P1 by 100 kg N/ha (3,125 g NPK/polybag); P2 by 150 kg N/ha (4,625 g NPK/polybag); P3 by 200 kg N/ha (6,125 g NPK/polybag); P4 = 250 kg N/ha (7,625 g NPK/polybag) and P5 = 300 kg N/ha (9,125 g NPK/polybag). Parameters observed were growth and production of sorghum. Results showed that NPK fertilizer was a significantly (P <0.05) by plant height, internode length and leaf blade length, while stem diameter, leaf width and number of leaves per plant was no significantly (P>0.05). Application of NPK fertilizer was a significant (P<0.05) by production of leaf dry matter, stem dry matter and leaf/stem ratio. It was concluded that NPK fertilizer increased the growth and production of sorghum ratoon.

1. Introduction
Sorghum [Sorghum bicolor (L.) Moench] is the fifth most important cereal crop grown in the world [1] that is widely adaptable and has great potential to be developed in Indonesia [2]. Sorghum also reported as a multi-purpose cereal, considered one of the most important crops for grain production for human consumption and livestock [3–5]. The advantage of the sorghum is can be harvested two to three times, including main and ratoon crops, so it can supply raw materials for carbohydrates, animal feed or bioethanol in a sustainable manner [6]. Ratooning practice was begun by cutting the stalks of sorghum to 1 inch high with a mower [8]. The main crop stumps should be left with at least 2–3 nodes for proper ratooning [7]. To achieve high yields, proper use of nutrients is an option. Fertilizers is a source of nutrients for plants. Due to the growth and production of plants require adequate supply and a balanced amount of all nutrients [11]. To maximize productivity by optimizing uptake of plant nutrients, adding fertilizers can increase forage production and grain yields for cereal crops [12]. The purpose of this study was to determine the effect of the level of NPK fertilizers application on the growth and production of ratoon sorghum. For this purpose, four levels of NPK fertilizer were used in this study.
2. Materials and methods

This research was conducted at the Faculty of Animal Science, Hasanuddin University Makassar, South Sulawesi. Research was carried out from March to June 2020 using Sorghum ratoon that was obtained from previous research. Each polybags were planted 2 plant. After the plants are harvested by cutting the stems, several new shoots (ratoon) would grow. New shoots (ratoon) are growing, each of which is selected 2 shoots, so that in one polybag there are 4 ratoons. Each stem has been cut in two buds (ratoon) so that in each polybag there are 4 shoots (ratoon) maintained for 45 days. The experiments were arranged in a completely randomized design (CRD) according to [13]. A total of 15 polybags pot filled with three shoots (ratoon) were divided into 5 treatments and each treatment was repeated 3 times. Each treatment was given a dose of NPK fertilizers (16:16:16) with different doses. The treatment were: P1 = 100 kg N/ha (3,125 g NPK/plastic pot); P2 = 150 kg N/ha (4,625 g NPK/polybag); P3 = 200 kg N/ha (6,125 g NPK/polybag); P4 = 250 kg N/ha (7,625 g NPK/polybag); P5 = 300 kg N/ha (9,125 g NPK/polybag). Fertilization is carried out singly around the stem of the plant. Plants are given sufficient water and maintained for 45 days, then measurements of plant growth and pruning are taken to determine forage production. The data obtained in this study was processed using SPSS 16, duncan test conducted against different treatment factors to show significant influence.

3. Results and discussion

3.1. Growth

Results of analysis of variance showed that application of NPK fertilizers was significantly (P<0.05) by plant height, internode length, leaf length, number of leaves per plant. While stem diameter and leaf width was no significantly (P>0.05) (table 1).

| Parameters                  | Fertilizers level |
|-----------------------------|-------------------|
|                             | P1          | P2          | P3          | P4          | P5          |
| Plant height (cm)           | 155±18.61a    | 191±7.21b   | 192±8.08a   | 197±10.44a  | 198±18.68a  |
| Stem diameter (cm)          | 1.13±0.7a     | 1.17±0.10b  | 1.32±0.14a  | 1.61±0.31a  | 1.47±0.42a  |
| Internode length (cm)       | 14.89±2.07c   | 18.44±1.54b | 21.78±1.35a | 22.00±1.76a | 22.28±0.94a |
| Leaf blade length (cm)      | 86.67±0.58b   | 95.00±4.58ab| 96.33±4.72a | 97.00±2.00a | 97.00±7.94a |
| Leaf width (cm)             | 5.00±0.50a    | 5.83±0.29a  | 5.83±0.29a  | 6.17±0.29a  | 6.50±0.87a  |
| Number of leaves/plant      | 8.00±0.00c    | 8.66±0.58bc | 9.00±0.58ab | 9.33±0.58ab | 9.67±0.58a  |

a, b, c Different superscripts within the same row showed significant differences (P <0.05).

Based on analysis of variance showed that the plant heights given NPK fertilizers at the P2, P3 and P4 levels were significantly (P<0.05) higher than those in P1 (control), while the P2, P3 and P4 levels were not significantly different (P>0.05). The results of this study were in line with the reports of Hussein and Alva [20] that increasing the level of NPK fertilizers is increased the height of sorghum plants.

The internode length increased significantly (P<0.05) from P1 to P2 and significantly (P<0.01) from P1 to P3, P4 and P5. The effect of fertilization on internode length in sorghum has also been reported by Nohong dan Islamiyati (2014) [14]. The length of the blades increased not significantly (P>0.05) from P1 to P2, but increased significantly to P3, P4 and P5. The number of leaves per plant at P5 increased significantly (P<0.01) compared to P1 (control) and significantly (P<0.05) compared to P2, P3 and P4. This study showed that the fertilizer can slow the senescence of leaves. According to [15] that compound fertilizers can slow the senescence of leaves.

3.2. Production

The application of NPK fertilizers was significantly (P<0.05) by the production of stem dry matter, leaf dry matter and stem leaf ratio (table 2). Statistical analysis showed that the dry matter production at P2, P3 and P4 was significantly (P<0.05) higher than in P1 (control), while the P2, P3 and P4 levels were
not significantly different (P>0.05). The increase in dry matter production was closely related to the increase in leaf length, leaf width and number of leaves per plant (table 1). The production of stem dry matter showed that the application of NPK fertilizer at the P2, P3 and P4 levels was significantly (P<0.05) higher than the P1 level (control), while the P2, P3 and P4 levels were not significantly different (P>0.05). The increase of dry matter production was related to the increase in internode length and stem diameter which increased due to fertilization. The leaf stem ratio was decreased because the fast growing plants were followed by enlargement and stem elongation cause the leaf/stem ratio to decrease. Increased dry matter production of sorghum with NPK fertilization has also been reported by several researchers, namely [17–19].

| Fertilizers level | P1       | P2       | P3       | P4       | P5       |
|-------------------|----------|----------|----------|----------|----------|
| Replication       | 25.13±6.48^b | 38.00±8.86^a | 40.41±3.23^a | 40.66±3.12^a | 43.70±2.68^a |
| 1                 | 5.87±3.80^b | 13.74±3.68^a | 16.48±0.46^a | 17.06±2.51^a | 17.88±0.27^a |
| 2                 | 5.91±1.46^b | 2.79±0.24^a | 2.45±0.23^a | 2.75±0.21^a | 2.61±0.16^a |

Different superscripts within the same row showed significant differences (P <0.05).

4. Conclusion
Based on the results and discussion, it can be concluded that NPK fertilizer increases the growth and production of forage sorghum.

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