The growth response and shallot production on some dosage of npk nitrate compound fertilizer 16-16-16

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Abstract. Fertilizer is considered to be one of the important factors in increasing shallot production. However, this must be followed by proper fertilization management to meet the nutrient requirements of the plant. This research was conducted with the aim of determining the correct dosage of NPK 16:16:16 based on ammonium nitrate in shallot plants. The assessment was carried out in October-December 2018. The research was carried out at one of the centers of shallot development, specifically in Batu Rampung Hamlet, Tanete Village, Angeraja Sub-District, Enrekang Regency, South Sulawesi. A randomized block design (RBD) was used in this research, accompanied by three replications and eight treatments: P1 = NPK Nitrate 16-16-16 450 kg/ha + Urea 150 kg/ha + ZA 300 kg/ha; P2 = NPK Nitrate 16-16-16 400 kg/ha + Urea 150 kg/ha + ZA 300 kg/ha; P3 = NPK Nitrate 16-16-16 350 kg/ha + Urea 150 kg/ha + ZA 300 kg/ha; P4 = NPK Nitrate 16-16-16 900 kg/ha; P5 = NPK Nitrate 16-16-16 800 kg/ha; P6 = NPK Nitrate 16-16-16 700 kg/ha; P7 = Urea 200 kg/ha + ZA 400 kg/ha + KCL 100 kg/ha; P8 = NPK Phonska 645 kg/ha + Urea 645 kg/ha + SP36 645 kg/ha. The results showed that NPK Nitrate Fertilization 16:16:16 at a dose of 700-900 kg/ha indicated a fairly high growth and production (14.5-16.3 t/ha). The results obtained were not significantly different from the high-dose fertilization used by farmers (17.2 t/ha), and higher than the single dose based on the recommendation (12.8 t/ha).

1. Introduction
Shallots (*Allium ascalonicum* L.) are one of the horticultural commodities that contribute many benefits and provide high economic value. This commodity belongs to the spice group which has been widely used as a spice traditionally from the ancient time, in connection with household and restaurant needs as well as raw materials for the food industry and herbal medicinal ingredients. Shallots have a relatively high level of consumption with an average of 0.12 g/capita/week [1].

Shallot farming has been successfully developed from the lowlands to the highlands. The farming system is considered to be a development from traditional subsistence methods to intensive and market-oriented farming methods. South Sulawesi has been recognized as one of the centers of shallots, particularly in Enrekang Regency and Bantaeng Regency. According to [1], the harvested area for shallots reached 10,363 ha with a production rate of 9.82 t/ha. The productivity of shallot yields is considered to be relatively lower than the potential yield of 10-20 t/ha⁻¹ [2.3].

The demand and need for shallots tends to increase every year, but the production has not been able to be increased properly. The inability to increase shallot production is due to the limited availability of quality seeds at the farmer level [4,5], and the high price of seeds of approximate 30.47% of production costs [6]. The high intensity of pest and disease incidence in certain seasons is also considered as the
main limiting factor which results in the low production of shallots. In addition, the decline in land fertility also occurs frequently, this is due to the hardening of the land in shallot production centers, depletion of micro-nutrients, contaminating groundwater, and the development of certain pests and diseases, leading to a decline in land and shallot plants productivity [7].

Optimal nutrient management through fertilization is considered to be an important component in a farming system that contributes significantly to the aspect of increasing soil fertility, increasing productivity and the quality of crops. Fertilizer has been widely used by the community and is very capable of providing benefits to farmers. Fertilizer is recognized as one of the important factors in obtaining high plant productions, which needs to be followed by proper fertilizer management to increase soil fertility and yields, and still promote an eco-friendly environment.

N, P, and K nutrients are known to be essential nutrients for plants. These three main nutrients are conventionally significant in the metabolic and biochemical processes of plant cells. These nutrients deficiency is very capable of being a limiting factor for plant growth. In addition, nutrients are considered to play a significant role, due to deficiencies that tend to occur in plants. [8,9] stated that NPK macro nutrients are highly needed for shallot plants in sufficient and balanced quantities to subsequently increase productivity and quality in yields or bulbs. The nitrogen element provided in shallots is recognized as having a significant effect on the production and quality of bulbs. Nitrogen is frequently used as a builder of nucleic acids, proteins, bioenzymes, and chlorophyll. Nitrogen deficiency will contribute to small bulb size and low water content. Whereas, nitrogen excess will provide a large bulb size and high water content, but is less well-filled of grain and is easily porous [10]. Phosphorus is considered to be a builder of nucleic acids, phospholipid, bioenzymes, proteins, and metabolic compounds as part of the important ATP in energy transfer. In addition, the Phosphorus element is recognized as very important in the process of root development, but its availability tends to be limited. Deficiency of P in shallots will reduce the growth of roots and leaves, size and yield of bulbs, but will subsequently support optimal aging. Potassium is used as a regulator of the balance of cell ions which play an important role in regulating various metabolic mechanisms such as photosynthesis. Potassium element also functions to maintain plant water status and cell turgor pressure, regulate stomata and regulate the accumulation and translocation of newly formed carbohydrates. The K provided in shallots has a significant effect on yield growth and bulb quality. K deficiency could inhibit growth, decrease disease resistance, and reduce shallot production [11].

Therefore, these three essential nutrients must be available in fertilization applications. On the other hand, the use of single fertilizers requires the most careful management and reapplication, and it may not be feasible to be used in advance of planting without applying some of the other nutrients, which causes farmers to experience difficulties in the application process. The use of compound fertilizers may cover considerable shortages of single fertilizers. Compound fertilizers contain more than one type of nutrient, have a more practical application in the field and are more homogeneous in the distribution of fertilizers that give precise and controlled release of the nutrients. Various types of NPK compound fertilizers have been produced and used by farmers, including NPK compound fertilizers based on nitrate (No. 3). This research was intended to determine the correct ammonium nitrate-based NPK 16:16:16 dosage in shallot plants.

2. Materials And methods
The assessment was carried out in October-December 2018. This research was implemented in one of the centers of shallot development, specifically in Batu Rampung Hamlet, Tanete Village, Angeraja Sub-District, Enrekang Regency, South Sulawesi.

The materials used in this research were the seeds of shallot bulbs using Tajuk variety, pesticides, urea, ZA, KCL, SP36, NPK Phonska and NPK Nitrate 16:16:16.

The assessment in this research used a randomized block design (RBD) with eight treatments and three replications. The treatment arrangement is as follows:

- P1 = NPK Nitrate 16-16-16 450 kg/ha + Urea 150 kg/ha + ZA 300 kg/ha
- P2 = NPK Nitrate 16-16-16 400 kg/ha + Urea 150 kg/ha + ZA 300 kg/ha
3. Result and Discussion

3.1 Soil Characteristics of the Research Site

The level of soil fertility in the research location was classified as moderate, where the soil pH was considered slightly acidic, the N content was very low, the P was low, the K was very high, and the cation exchange capacity (CEC) and base saturation (BS) were very high (Table 1). Low N and P nutrients content indicated that the soil condition still requires fertilization with appropriate doses, particularly high N and P nutrients. Based on the results of the analysis carried out in this research, the soil texture was classified as clay sand soil. The soil texture is suitable for bulb plants such as shallots, because the bulbs will easily develop. According to [2], ideal soil conditions for shallots are soil with a crumb structure, medium to clay texture, good drainage/aeration, containing sufficient organic matter, and non-acid soil reactions (soil pH: 5.6 - 6.5). Apart from inorganic fertilizers, organic fertilization was also required at the research site to increase soil pH and the low organic matter content of the soil.
Table 1. Results of soil analysis at the research site

| Type of Analysis             | Unit  | Value | Criteria* |
|-----------------------------|-------|-------|-----------|
| Physical Properties (texture) | %     |       |           |
| Sand                        | %     | 75    | Clay Sand |
| Dust                        | %     | 18    |           |
| Clay                        | %     | 7     |           |
| Chemical Properties         |       |       |           |
| pH-\(\text{H}_2\text{O}\)   | - Log | 6.21  | Slightly Acidic |
| pH-KCL                      | H     | 5.73  |           |
| C-organic                   | - Log | 1.63  | Low       |
| N-total                     | H     | 0.09  | Very low  |
| C/N                         | %     | 18    | High      |
| P (Bray)                    | %     | 4     | Low       |
| K (Bray)                    | %     | 115   | Very high |
| Exchange Cations            | ppm   |       |           |
| Ca                          | ppm   | 30.32 | Very high |
| Mg                          | ppm   | 1.39  | Moderate  |
| K                           | me/100 gr | 0.24 | Low       |
| Na                          | me/100 gr | 0.20 | Low       |
| Cation Exchange Capacity (CEC) | me/100 gr | 42.53 | Very high |
| Base Saturation (BS)        | me/100 gr | 76   | Very high |

* Indonesian Soil Research Institute

3.2 Plant Growth

The results of the analysis of variance indicated that the application of NPK nitrate fertilizer with 8 different doses had no significant effect (P>0.05) on plant height and the number of shallot tillers at the 15 and 45 days after planting (DAP). These results revealed that the application of fertilization doses contributed to the same effect on plant height growth and the number of shallot tillers. The increase in plant height and number of tillers is presented in detail in Table 2 and Table 3. Fertilization was carried out based on the recommendations of the Balitsa [2], specifically 200 kg urea + 400 kg Za + 100 kg KCL (P7) which indicated the plant height (25.6 cm) and the maximum number of tillers (4.7) at the age of 15 DAP. Treatment according to farmer method (P8) and fertilization of 800 kg NPK Nitrate (P5) showed the highest shallot plant height at 45 DAP by 40.8 cm and 40.9 cm respectively (Table 2). The treatments on P3 (350 kg NPK Nitrate + 150 kg urea + 300 kg Za) and P6 (700 kg NPK Nitrate) showed the more tillers with 10.6 and 10.2 tillers, respectively at the age of 45 DAP.

The results showed that NPK nitrate fertilization contributed relatively similar growth to the farmer’s method (P8) and the recommended dosage (P7). NPK nitrate contains N element in the form of nitrate. In addition, Nitrate can be used as an alternative in adding N element. The use of nitrate as a source of N in shallots was reported by the research of [2], which indicated that calcium nitrate inorganic fertilizers could effectively contribute to improving the growth and quality of shallot plant bulbs.

Table 2. Effect of fertilization on the height of shallot plants

| Treatment                                      | Plant Height (DAP) |
|------------------------------------------------|--------------------|
|                                                 | 15                | 45                |
| 450 kg NPK Nitrate + 150 kg urea + 300 kg Za (P1) | 24.7 a            | 39.9 a            |
| 400 kg NPK Nitrate + 150 kg urea + 300 kg Za (P2) | 24.4 a            | 39.6 a            |
| 350 kg NPK Nitrate + 150 kg urea + 300 kg Za (P3) | 25.1 a            | 39.6 a            |
| 900 kg NPK Nitrate 16:16:16 (P4)                 | 24.4 a            | 37.7 a            |
800 kg NPK Nitrate 16:16:16 (P5)  24.5  a  40.9  a
700 kg NPK Nitrate 16:16:16 (P6)  23.6  a  39.4  a
200 kg urea + 400 kg Za + 100 kg KCL  (P7)  25.6  a  38.5  a
645 kg NPK Phonska + 645 kg urea + 645 kg SP-36  (P8)  24.7  a  40.8  a

Information; The numbers followed by the same letter were not significantly different according to the Duncan test with a significance level of 5%.

Table 3. Effect of fertilization on the number of shallot tillers

| Treatment                                                                 | Number of Tillers (DAP) |
|---------------------------------------------------------------------------|-------------------------|
|                                                                          | 15                      | 45                      |
| 450 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P1)                        | 3.6 a                    | 8.8 a                    |
| 400 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P2)                        | 4.3 a                    | 9.9 a                    |
| 350 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P3)                        | 4.6 a                    | 10.6 a                   |
| 900 kg NPK Nitrate 16:16:16  (P4)                                         | 4.6 a                    | 9.2 a                    |
| 800 kg NPK Nitrate 16:16:16  (P5)                                         | 4.3 a                    | 9.7 a                    |
| 700 kg NPK Nitrate 16:16:16  (P6)                                         | 3.9 a                    | 10.2 a                   |
| 200 kg urea + 400 kg Za + 100 kg KCL  (P7)                                | 4.7 a                    | 9.4 a                    |
| 645 kg NPK Phonska + 645 kg urea + 645 kg SP-36  (P8)                    | 4.6 a                    | 8.5 a                    |

Information: The numbers followed by the same letter were not significantly different according to the Duncan test with a significance level of 5%.

3.3 Yield Components and Yield of Shallots

Analysis of variance showed that the process of providing NPK Nitrate had a significant effect (P<0.05) on the number of bulbs, fresh weight of bulbs/plant and fresh weight of bulbs/plot, but had no significant effect (P>0.05) on fresh weight per bulb. Fertilization treatment dose of 350 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P3) showed the maximum number of bulbs with 12 bulbs/clump, which was not significantly different from NPK Nitrate fertilization doses (P1, P2, P3, P4, P5, P6) but significantly different from the recommended dosage treatment of Balitsa (P7) and the fertilizer dose of farmers (P8). The highest fresh bulb/plant weight at the treatment dose of 800 kg NPK Nitrate (P5), with 107.8 g/plant, was significantly different from (P7) and was not significantly different from other NPK Nitrate fertilization treatments (P1, P3, P4, P5, P6). The wet weight of the plant/plot was indicated to be higher in the dose provided by the farmer (P8), specifically 3.1 kg/plot, which was significantly different from the P2 and P3 treatments and was not significantly different from other treatments. (Table 4).

Table 4. Effect of fertilization on the number of bulbs and fresh weight of shallot bulbs

| Treatment                                                                 | Number of Bulbs | Fresh weight of bulbs |
|---------------------------------------------------------------------------|-----------------|-----------------------|
|                                                                          |                 | Gr/tan | gr/bulb | Kg/1m²    |
| 450 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P1)                        | 9.4 ab          | 88.4 b | 9.6     | 2.7 abc   |
| 400 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P2)                        | 9.5 ab          | 85.7 b | 9.5     | 2.3 bc    |
| 350 kg NPK Nitrate + 150 kg urea + 300 kg Za  (P3)                        | 12.0 a          | 96.7 ab| 8.2     | 2.1 c     |
| 900 kg NPK Nitrate 16:16:16  (P4)                                         | 10.8 ab         | 96.6 ab| 9.3     | 2.6 abc   |
| 800 kg NPK Nitrate 16:16:16  (P5)                                         | 11.7 a          | 107.8 a| 10.0    | 2.9 ab    |
| 700 kg NPK Nitrate 16:16:16  (P6)                                         | 11.4 a          | 94.9 ab| 8.9     | 3.0 a     |
| 200 kg urea + 400 kg Za + 100 kg KCL  (P7)                                | 8.3 b           | 58.3 c | 7.7     | 2.6 abc   |
| 645 kg NPK Phonska + 645 kg urea + 645 kg SP-36  (P8)                    | 8.3 b           | 87.5 b | 10.9    | 3.1 a     |

Information: The numbers followed by the same letter were not significantly different according to the Duncan test with a significance level of 5%.
| Treatment                                                                 | Dry Weight | Production |
|---------------------------------------------------------------------------|------------|------------|
|                                                                         | gr/tan     | gr/bulb    | Kg/1m²    | (t/ha)    |
| 450 kg NPK Nitrate + 150 kg urea + 300 kg ZA (P1)                        | 67.2 bc    | 7.2        | 2.0 bc    | 14.5 bc   |
| 400 kg NPK Nitrate + 150 kg urea + 300 kg ZA (P2)                        | 68.1 bc    | 7.5        | 1.9 bc    | 13.3 bc   |
| 350 kg NPK Nitrate + 150 kg urea + 300 kg ZA (P3)                        | 77.1 bc    | 6.6        | 1.7 c     | 11.7 c    |
| 900 kg NPK Nitrate 16:16:16 (P4)                                         | 83.9a      | 8.1        | 2.2 ab    | 14.5 ab   |
| 800 kg NPK Nitrate 16 :16 :16 (P5)                                       | 78.8ab     | 7.4        | 2.3 ab    | 15.8 ab   |
| 700 kg NPK Nitrate 16 :16 :16 (P6)                                       | 76.9ab     | 7.2        | 2.3 ab    | 16.3 ab   |
| 200 kg urea + 400 kg ZA + 100 kg KCL  (P7)                                | 45.5d      | 6.0        | 1.8 bc    | 12.8 bc   |
| 645 kg NPK Phonska + 645 kg urea + 645 kg SP-36 (P8)                      | 62.0 c     | 7.9        | 2.5 a     | 17.2 a    |

Information: The numbers followed by the same letter were not significantly different according to the Duncan test with a significance level of 5%.

The treatment of NPK Nitrate fertilizer did not contribute significantly (P>0.05%) to the dry weight/bulb, but had a significant effect (P<0.05%) on dry bulb weight/plant, dry bulb weight/plot and bulb production (t/ha). Fertilization according to the farmer’s method (P7) (645 kg NPK Phonska + 645 kg urea + 645 kg SP-36) showed that the highest production of shallot bulbs was 17.2 t/ha, which was not significantly different from the production of bulbs obtained in a single NPK Nitrate treatment dose of 900 kg/ha (P4) which was amounted to 14.5 t/ha, 800 kg/ha (P5) 15.8 t/ha and a dose of 700 kg/ha (P6) which was amounted to 16.3 t/ha. The lowest bulb production was obtained at treatment (P3) dose of 350 kg NPK Nitrate + 150 kg urea + 300 kg ZA, which was not significantly different from P1 (450 kg NPK Nitrate + 150 kg urea + 300 kg ZA), P2 (450 kg NPK Nitrate + 150 kg urea + 300 kg ZA) and the recommended dosage of Balitsa (P7) (Table 5). This indicated that the administration of NPK Nitrate at doses of 700-900 kg/ha (treatment P4, P5 and P6) tended to be quite effective and provided a positive impact for the growth and production of shallot bulbs. The average value of plant growth (Table 2 and Table 3) and yield components (Tables 4, and 5) indicated that the single NPK Nitrate fertilizer treatment (P4, P5 and P6) tended to be high and was not statistically different from the farmer’s dose treatment (P8).

The results of research by [13] on potato plants showed that the ammonium nitrate-based NPK compound fertilizer formula was relatively better for the growth of potato plants and was able to increase the productivity of potatoes in the highlands in Lembang, Bandung by 11.5% compared to Urea-based NPK fertilizer formula. This was due to the P and K nutrients in the NPK compound fertilizer formula based on ammonium nitrate which were considered not easily washed by water and the dissolution process was also gradual, thus ensuring the need for plant nutrients at each growth phase. The formula was significantly different from the urea-based NPK compound fertilizer formula which was easily washed by rainwater or evaporated due to irradiation, so that the nutrients absorbed by plants were not proportional to the dose given due to the reduced nutrients, particularly the K nutrients.

NPK compound fertilizer is a fertilizer that specifically contains 5 nutrients consisting of 3 macro nutrients, namely N, P and K and 2 micro nutrients. NPK nitrate contains nutrients that are easily absorbed, especially horticultural plants in the form of bulbs and fruit. Nitrate is the readily available form of Nitrogen to plants. In addition, phosphorus is considered vital to the growth of plants which also tends to be found in every living plant cell. It is involved in several key plant functions, including strengthen roots, plant stems and potassium, and which functions to improve the quality of fruit and seeds. N, P and K nutrients particularly have specific functions for plants, namely (1) N element which could help the growth related to the photosynthetic process, namely leaves, (2) P element as an important element of adenosintriphosphate (ATP) which directly plays a significant role in the process of energy storage and transfer associated with plant metabolic processes and could play a role in increasing plant production and flower formation in legume plants, (3) K element which acts as an activator for various

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Table 5. Effect of fertilization on dry bulb weight and production of shallots

| Treatment                                                                 | Dry Weight | Production |
|---------------------------------------------------------------------------|------------|------------|
|                                                                         | gr/tan     | gr/bulb    | Kg/1m²    | (t/ha)    |
| 450 kg NPK Nitrate + 150 kg urea + 300 kg ZA (P1)                        | 67.2 bc    | 7.2        | 2.0 bc    | 14.5 bc   |
| 400 kg NPK Nitrate + 150 kg urea + 300 kg ZA (P2)                        | 68.1 bc    | 7.5        | 1.9 bc    | 13.3 bc   |
| 350 kg NPK Nitrate + 150 kg urea + 300 kg ZA (P3)                        | 77.1ab     | 6.6        | 1.7 c     | 11.7 c    |
| 900 kg NPK Nitrate 16:16:16 (P4)                                         | 83.9a      | 8.1        | 2.2 ab    | 14.5 ab   |
| 800 kg NPK Nitrate 16 :16 :16 (P5)                                       | 78.8ab     | 7.4        | 2.3 ab    | 15.8 ab   |
| 700 kg NPK Nitrate 16 :16 :16 (P6)                                       | 76.9ab     | 7.2        | 2.3 ab    | 16.3 ab   |
| 200 kg urea + 400 kg ZA + 100 kg KCL  (P7)                                | 45.5d      | 6.0        | 1.8 bc    | 12.8 bc   |
| 645 kg NPK Phonska + 645 kg urea + 645 kg SP-36 (P8)                      | 62.0 c     | 7.9        | 2.5 a     | 17.2 a    |
kinds of essential enzymes in the process of photosynthesis and respiration as well as for enzymes that help in protein and starch synthesis [14016]. According to [17], the addition of NPK fertilizer is able to contribute to the growth process and plant development as indicated by the increase in plant size and dry weight. Kong et al., (2004) in [18] reported that the combination of NPK could increase crop yields, and also increase soil nutrients and soil fertility status in the long term.

Several research results indicated that the NPK nutrient application process provided a significant effect on the growth and production of shallot and other horticultural plants. Suwandi et al., (2012) reported that the combination of NPK fertilization at the level of 200 kg N/ha, 135 kg P\textsubscript{2}O\textsubscript{5}/ha, and 150 kg K\textsubscript{2}O/ha and the application of POC to the soil could increase the weight of the yield components of shallots. The application of 200 kg/ha Urea and 200 kg/ha ZA fertilizers on Andisols increased the dry bulb weight of shallots by 22.6%, while for Brebes Alluvial soils, nitrogen fertilization was able to increase the dry weight of shallot bulbs (29.3–49.3%) [12]. The highest production of fresh bulbs per plant and production of dry bulbs per plant was obtained by giving 500 kg/ha of NPK Phonska fertilizer + 2.5 t/ha of organic fertilizer (Petroganik) + 10 kg/ha of biological fertilizer (Biotricho), but was not significantly different with the provision of 250 kg/ha NPK Phonska + 2.5 t/ha organic fertilizer (Petroganik) [7].

Research conducted by [20] stated that the application of NPK fertilizer had a very significant effect on the dry seed weight of peanuts per m\textsuperscript{2}. In addition, research by Rivaliati et al., (2017) on green beans indicated that the application of fertilizer (NPK25-7-7 + Nitrate 3%) + Petrobiofertile produced the highest plant weight, pod weight, seed weight, shell weight and the maximum number of pods than other NPK doses. This is in line with Firmansyah et al., (2017) who stated that NPK fertilization had a positive effect on the growth and production of eggplant plants, the treatment of NPK fertilizer doses of 200 kg/ha, 100 kg P\textsubscript{2}O\textsubscript{5}/ha, and 75 kg K\textsubscript{2}O/ha provided the most significant effect on all observations.

The farmer treatment (P8) tended to contribute to high growth and bulb production, which was caused by a high enough fertilizer dose (645 kg NPK Phonska + 645 kg urea + 645 kg SP-36). Economically, high fertilization doses are considered less profitable in terms of production costs. In addition, continuous high-dose inorganic fertilization is considered as a way of managing fertilizers that is not environmentally friendly and unsustainable [21]. Because in long-term conditions, the inorganic fertilization process subsequently contributes to the adverse impact on soil damage, and reduces and suppresses the population of beneficial soil microorganisms such as bacteria, earthworms, fungi and others [18].

4. Conclusions

NPK Nitrate Fertilization 16:16:16 at a dose of 700- 900 kg/ha showed a fairly high growth and production (14.5-16.3 t/ha). The results obtained in this research were not significantly different from the high-dose fertilization used by farmers (17.2 t/ha), and higher than the single dose based on the recommendation (12.8 t/ha).

References

[1] BPS, 2019. Statistik Tanaman Hortikultura Sulawesi Selatan. Badan Pusat Statistik Provinsi Sulawesi Selatan.
[2] Sumarni, N dan A.Hidayat 2005. Panduan Teknis Budidaya Bawang Merah. Balai Penelitian Tanaman Sayuran. Pusat Penelitian dan Pengembangan Pertanian Badan Penelitian dan Pengembangan Pertanian. Lembang. 20 halaman.
[3] Thamrin, M. Ramlan, Armiat, Ruchjatiningsih dan Wahdania. 2003. Pengkajian Sistim Usahatani Bawang Merah di Sulawesi Selatan. Jurnal Pengkajian dan Pengembangan Teknologi Pertanian 6(20):141-153.
[4] Putrasamedja, S dan A.H. Permadi. 2001. Varietas bawang merah unggul baru Kramat-1, Kramat-2, dan Kuning. J.Hort., 11(2): 143 147.
[5] Rajiman. 2017. Kajian teknologi dan prospek budidaya bawang merah sub optimal di musim penghujan untuk benih. J. Ilmu-ilmu Pertanian, 24 (1): 22 - 29.
[6] Adiyoga, W, Soetiarso, TA, Ameriana, M & Setiawati, W 2009, ‘Pengkajian ex ante manfaat potensial adopsi varietas unggul bawang merah di Indonesia’, J. Hort., vol. 19, no. 3, hlm. 356-70.

[7] Suwandi., Sopha GA dan Yufdy, MP. 2015. Efektivitas Pengelolaan Pupuk Organik, NPK, dan Pupuk Hayati terhadap Pertumbuhan dan Hasil Bawang Merah. J.Hort. Vol. 25(3), 208-221

[8] Sumarni, N., R. Rosliani dan R.S. Basuki. 2016. Respons Pertumbuhan, Hasil Umbi, dan Serapan Hara NPK Tanaman Bawang Merah terhadap Berbagai Dosis Pemupukan NPK pada Tanah Alluvial. Jurnal Hortikultura. 22 (4): 366-375.

[9] Suwandi, N., G.A. Sopha, L. Lukman, dan M.P. Yufdy. 2017. Efektivitas Pupuk Hayati Unggulan Nasional Terhadap Pertumbuhan dan Hasil Bawang Merah. J. Hortik. 27 (1): 23-34

[10] Singh, S. P. and Verma, A. B. 2001. Response of Onion (Allium cepa L.) to Pottasium Application. Indian Journal of Agronomy. 46 : 182-185

[11] Akhtar, M., E., K., Bashir, M. Z. Khan, and K.M. Khokhar, 2003. Effect of Potash Application on Yield of Different Varieties of Onion (Allium cepa L.). Asian Journal of Plant Sciences. 1 (4) : 324-325.

[12] Aisyawati L. dan F. N. Azis. 2020. Respon pertumbuhan dan hasil bawang merah terhadap pupuk kalsium nitrat. Jurnal Ilmu-Ilmu Pertanian, Vol 14 (1): 11-20

[13] Sutrisna, N dan Surdianto, Y. 2014. Kajian Formula Pupuk NPK Pada Pertanaman Kentang Lahan Dataran Tinggi di Lembang Jawa Barat. J. Hort. 24(2):124-132.

[14] Subhan, N., Nurtika dan Setiawati,W 2005. Peningkatan efisiensi pemupukan nkp dengan memanfaatkan bahan organik terhadap hasil tomat. Jurnal Hortikultura 15(2), 91-96.

[15] Rizwan, M. 2008. Evaluasi Pupuk NPK dan pupuk organik terhadap pertumbuhan dan produksi tanaman kacang. Jurnal Ilmiah Abdi Ilmu 3 (2), 150-158

[16] Firmansyah I, M. Syakir dan L. Lukman. 2017. Pengaruh Kombinasi Dosis Pupuk N, P, dan K Terhadap Pertumbuhan dan Hasil Tanaman Terung (Solanum melongena L.) J.Hort. Vol. 27 (1): 69-78

[17] Minardi, S. 2002. Kajian komposisi pupuk NPK terhadap hasil beberapa varietas tanaman buncis tegak (Phaseolus vulgaris L.) di tanah Alfisol. Sains Tanah 2(1), 18-24.

[18] Anggraini NFD, Y. Nuraini dan C. Prayogo. 2017. Efek residu pemupukan NPK berbasis ammonium dan nitrat terhadap ketersediaan hara, kelimpahan bakteri serta pertumbuhan dan hasil tanaman sawi. Jurnal Tanah dan Sumberdaya Lahan Vol 4 No 1 : 481-492.

[19] Suwandi, Sumarni, N, Firmansyah, I &Sutarya, R 2012. Teknologi LEISA dalam pengelolaan pupuk in-organik untuk mengurangi emisi gas rumah kaca (<25%) di dataran rendah, Laporan Hasil Penelitian, Balitsa, Lembang.

[20] Suha, L. N. 2003. Pengaruh Dosis Pupuk Kompos dan Pupuk N, P, K Terhadap Ketersediaan dan Serapan N serta Hasil Tanaman Kacang Tanah di Alfisols Jumantono.Skripsi FP UNS.

[21] Narkhede, SD. Attarde, SB & Ingle, ST 2011,’Study on effect of chemical fertilizer and vermicompost on growth of chili pepper plant (Capsicum annuum L.’), Journal of Applied Sciences in Environmental Sanitation, vol. 6, no. 3, pp. 327-32.