

Effect of Cow Manure and Atonic on Spinach (*Amaranthus* spp.) Production in Dry Land

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Abstract: East Nusa Tenggara is dominated by dry land which has the potential for the development of horticultural crops. Horticultural plants that are widely cultivated by the community are spinach. However, in reality, spinach production in this province is still fluctuating, this is due to the low knowledge of farmers about providing proper nutrition for plant growth and development. For this reason, this study aims to determine the production of spinach in dry land due to cow manure and atonic application. This research was conducted in the experimental field of the Faculty of Agriculture, University of the Teachers Association 1945. The design used was a factorial randomized block design (RBD), which consisted of 2 factors: factor I: cow manure and factor II: growth stimulant (atonic). The results obtained were: The application of cow manure and atonic manure to spinach on dry land had a very significant effect on plant height (7,55 -F hitung > 4,77-F Tabel), number of leaves (10,85-F hitung > 4,77-F Tabel), fresh weight (13,98-F hitung > 4,77-F Tabel) and dry weight (6,44 -F hitung > 4,77 -F Tabel).

Keywords: *Amaranthus* spp; organic fertilizer; Atonic; dry land

Introduction

Kupang Regency is dominated by dry land, with an area of 523,620 ha or 96.53% with a dry climate as indicated by an average rainfall of 3 - 4 wet months, the remaining dry months. The land area of Kupang Regency is 542,397 ha with altitudes ranging from 0 - 1,200 m asl, the topography is generally hilly with a slope of 40% of the total area (BPS NTT, 2018). Spinach is a short-lived seasonal plant that can adapt to dry land so that it can be cultivated easily in the yard. Spinach is useful as medicine and contains vitamins A, B, C, calories, protein, fat, carbohydrates, calcium, phosphorus and iron (Suwarni Et.al, 2003). Spinach production data in NTT for 2013-2015 explains that spinach production in NTT for the last 3 years has decreased. This is due to the low level of farmers' knowledge of spinach cultivation techniques and soil fertility, so fertilization is needed to ensure the availability of spinach production in the market (BPS, 2018).

One of the fertilizers that is easily available and available in almost all regions of NTT is cow manure. This fertilizer has natural properties and does not damage the soil, providing macro elements (nitrogen, phosphorus, potassium, calcium, and sulfur) and micro (iron, zinc, boron, cobalt, and molybdenum) (preliminary survey,

2019). Other than that, Manure serves to increase water retention, soil microbiological activity, value of cation exchange capacity and improve soil structure (Magdalena, 2013). Cow manure in the form of solid manure (feces) mixed with food scraps and urine (urine) containing macro and micro elements such as nitrogen (N), phosphate (P), potassium (K), calcium (Ca), magnesium (Mg), and manganese (Mn) which plants need and play a role in maintaining the balance of nutrients in the soil, because cow manure has long-term effects and is a food store for plants. Apart from using fertilizers, spinach plants also need additional growth hormones, one of the sources of growth hormone that is often used by farmers, namely atonic (Pioner, 2020).

Atonic is a growth stimulant containing the auxin hormone which acts to stimulate the growth of plant roots, increase water absorption, accelerate leaf growth and increase the number and weight of fruit (Rismawati, 2013). Atonics work biochemically directly through the roots, stems, leaves and flower buds which affect the flow of nutrients into cells and provide vital force to accelerate growth. Based on the description above, it is necessary to conduct research on "Spinach Production (*Amaranthus* spp.) Due to the provision of Cow and Atonic Manure in Dry Land". The objectives of this study were: to determine

the effect of cow manure and atonic manure on spinach production in dry land.

Materials and Methods

Place and time of research

This research was conducted in October - December 2019, on the experimental field of the Faculty of Agriculture, University of Teachers' Union 1945, NTT which is located in Batuplat Village, Kota Raja District - Kupang City.

Materials and Tools

The materials used in this study were local spinach seeds taken from farmers, cow manure and atonic. The tools used in this study were hoes, machetes, gembor, tape measure, scales, soil sieve, wood, ropes, knives, cameras and stationery.



Picture 1. Cow manure and atonic

Research design

The design used was a factorial randomized block design, which consists of 2 factors, namely factor I: provision of cow manure and factor II: provision of growth stimulants (atonic).

Factor I = Cow manure (K)

- K1 = 10 tha^{-1} cow manure is equivalent to 1 kg plot^{-1}
K2 = 15 tha^{-1} cow manure is equivalent to 3 kg plot^{-1}
K3 = 20 tha^{-1} cow manure is equivalent to 6 kg plot^{-1}

Faktor II = atonic (A).

- A1 = Atonic 2 cc liter water^{-1}
A2 = Atonic 3 cc liter water^{-1}
A3 = Atonic 4 cc liter water^{-1}

There were 9 treatment combinations and 3 repetitions were carried out, in order to obtain 27 experimental units.

Research Implementation

Preparation of seeds

The seeds used are local variety seeds. The seeds are sown first with soil seeding media and cow manure with a ratio of 2: 1. After the seeds are 10 days old, they are transferred to the beds.

Land preparation

Before planting spinach, the land (dry land) is cleared of grass. The land is processed using a hoe with a depth of about 20-30 cm or around the tillage layer, then

make a bed with the size of each bed is 2 m x 1.5 m (P x L). The distance between the beds is 30 cm and the distance between the repeat blocks is 50 cm. After that it is placed, trimmed and given cow manure according to the treatment dose.

Planting

Before planting spinach, first make a planting hole, with a spacing of 20 cm x 20 cm. After that, put the spinach plant into the available hole. The number of spinach / hole plants is 2 plants. When the plants are 2 weeks old, thinning them is done leaving a healthy plant. Fertilization. The application of cow manure is carried out 1 week before planting with a dose according to treatment by spreading it evenly on the surface of the bed, then mixing it evenly with the ground using a hoe. After that, do watering and keep the humidity until planting. Cow manure used is fertilizer that is ripe with the characteristics of a dark color, smooth texture and does not smell strong. Atonic application was carried out twice at the age of 7 and 14 days after the concentration and time of application according to the treatment. Fertilizer is applied in the morning using a sprayer and sprayed on the leaves of the plant.

Maintenance

- Embroidery
Replanting is done after the plants are 10 days after planting, the purpose of embroidery is to replace plants that are wilted, dead or not growing.
- Watering.
Watering is carried out in the afternoon with the volume of water supplied to field capacity.
- weeding
Weeding is done when there are weeds growing around the plant.
- Storage
The seasoning is done once a week, the purpose of which is to make the soil loose and to provide soil air circulation.
- Pest and disease control
Pest and disease control is carried out when there is an attack on the plant.

Harvest

Harvesting is done when the plants are 25 days after planting. With the physical condition of the spinach plant which has characteristics, namely the lower leaves have started to turn yellow, the plant has not yet flowered and the size of the plant has been maximized both leaves, stalks and stems.

Variabel Penelitian

- Plant height (cm).

Obtained by measuring the height of the plant from the base of the stem to the tip of the highest leaf at the age of 25 days after planting.

2. Number of leaves (strands)

Obtained by counting the number of leaves that have opened perfectly in the sample plant, and this is done on aged plants 25 days after planting.

3. Plant fresh weight (g).

Obtained by calculating plant fresh weight per sample plant at planting and at harvest.

4. Dry weight of stover (g)

Obtained by calculating the plant dry weight per sample plant after being oven for 24 hours at a temperature of 24 °C.

Data analysis

The analytical model used in this study is a mathematical method using a randomized block design (Suhaemi, 2011).

$$Y_{ij} = \mu + T_i + \beta_j + \epsilon_{ij}$$

note:

Y_{ij} : The observed value of the i th treatment and j th repetition

- μ : Common mean
- β_j : Effect of repeat to - j
- T_i : Treatment effect to - i
- i : The number of treatments (1,2,3,4 and 5)
- j : The number of tests (1,2,3,4,5 and 6)
- ϵ_{ij} : Effect of treatment and repeat errors

The research data obtained were analyzed using ANOVA analysis of variance to determine the effect of the treatment being tested, If there is a significant difference in this test, then continue with Duncan's continued test at the 5% level.

Results and Discussion

1. Plant Height

The results of analysis of variance showed that the interaction of cow manure and atonic manure had a very significant effect on the height of spinach. The average height of spinach plants due to cow manure and atonic manure can be seen in table 1.

Table 1. Average height of spinach plants due to cow manure and atonic manure (cm)

Factor K	Factor A			Average
	A1	A2	A3	
K1	69.8 a	73 b	74.3 c	24.122
K2	77.3 d	79 e	80.5 f	26.311
K3	82.9 g	85.4 h	91 i	28.811
Average	19.167	19.783	20.483	19.811

Note: The numbers followed by the same letter in the same column are not significantly different in the Duncan test (5%).

The results of the Duncan test (5%) showed that the highest spinach plant height was in the K3A3 treatment (20 tha^{-1} cow manure is equivalent to 6 kg plot^{-1} and atonic concentration of 4 cc liters of water^{-1}) and significantly different from other treatments. This is because the interaction of organic cow manure and atonic manure can increase the vegetative growth of spinach plants. Cow manure contains macro and micro nutrients in a balanced manner so that it can supply nutrients for plant growth. In addition, cow manure organic fertilizer can help improve soil structure so as to facilitate root growth and help the process of absorption of nutrients and water (Dedi, 2015).

Atonic increases root growth so as to increase the absorption of nutrients and water. In addition, atonic contains the hormone auxin, which plays a role in plant growth and production. Gardner (1991), explained that auxins play a role in stimulating growth by elongating cells and causing tip domination. The lowest maize plant height was in K1A1 treatment and was significantly different from other treatments. The low height of spinach in this treatment is because the plants are deficient in nutrients and inadequate exogenous hormones which result in inhibition of plant growth. Lakit (2012) explains that giving hormones in the appropriate concentration can increase plant morphogenesis, but if the growth regulators are given in excessive concentrations it will become an inhibitor for the growth of plant morphogenesis.

2. Number of leaves

The results of the analysis of variance showed that the interaction of cow manure and atonic manure had a very significant effect on the number of spinach leaves. The average number of spinach leaves due to cow manure and atonic manure can be seen in table 2.

Table 2 Average number of spinach leaves due to cow manure and atonic application (strands)

Factor K	Factor A			Average
	A1	A2	A3	
K1	30.0 a	36.5 b	41.5 c	12.000
K2	44 d	47 e	52 f	15.889
K3	55 g	57.5 h	60 i	19.167
Average	10.750	11.750	12.792	11.764

Note: The numbers followed by the same letter in the same column are not significantly different in the Duncan test (5%).

The results of the Duncan test (5%) showed that the highest number of spinach leaves was in the K3A3

treatment 20 tha^{-1} cow manure is equivalent to 6 kg plot⁻¹ and atonic concentration of 4 cc liters of water⁻¹) and significantly different from other treatments. This is because the interaction of organic cow manure and atonic manure is able to interact well in supplying nutrients and growth hormones which results in an increase in the number of spinach leaves. Cow manure contains macro and micro nutrients in balance, then atonic maximizes absorption. The more nutrients that are absorbed by plants, the more the plant's needs for nutrients are met. With the fulfillment of plant needs for nutrients, it can result in all plant components developing perfectly in both the vegetative and generative phases (Hariatik, 1992). The N nutrient absorbed by plants serves to encourage the growth of organs related to the photosynthesis process. The element N is also one of the elements needed for the development of organs in the vegetative phase, one of which is the formation of leaves (Bustami, 2012). Increased absorption of nutrients will increase the photosynthetic process which has an impact on plants and plant development.

The table above explains that the lowest number of spinach leaves was found in K1A1 treatment and was significantly different from other treatments. The low number of leaves in the treatment was due to the low absorption of nutrients. Dedi (2015), states that soil that is lacking in nutrients results in poor structure, so that it will affect the overall growth rate of plants, especially the role of N in the process of forming leaves that are not optimal.

3. Plant Fresh Weight

The results of analysis of variance showed that the interaction of cow manure and atonic manure had a very significant effect on the fresh weight of spinach. The average fresh weight of spinach plants due to cow manure and atonic manure can be seen in table 3.

Table 3 Average fresh weight of spinach plants due to cow manure and atonic application (gr)

Factor K	Factor A			Average
	A1	A2	A3	
K1	59.5 a	66.5 b	69.5 c	21.722
K2	73 d	75.5	77.5 e	25.111
K3	81.8 f	91 g	93.5 h	29.589
Average	17.858	19.417	20.042	19.106

Note: The numbers followed by the same letter in the same column are not significantly different in the Duncan test (5%).

The Duncan test results (5%) showed that the highest fresh weight of spinach was in the K3A3 treatment (20 tha^{-1} cow manure is equivalent to 6 kg plot⁻¹ and atonic concentration of 4 cc liters of water⁻¹) and significantly different from other treatments. This is because the

interaction of organic cow manure and atonic manure is able to interact well in supplying nutrients and growth hormones which results in an increase in the number of spinach leaves so that it has an impact on increasing photosynthetic activity (Pioner, 2020). Manure can effectively increase the cation exchange capacity is the ability of the soil to increase the interaction between ions in the soil so that it can provide the various elements needed by plants. Dede (2015), states that the nutrient potassium will enhance the movement of photosynthate from the leaves to the roots and the development of plant size. The lowest average plant fresh weight was found in treatment K1A1 and was significantly different from other treatments. This is due to the lack of nutrients and growth hormones needed by spinach during plant growth and development. Muhamad (2015), explained that if the nutrients needed by plants are available in sufficient quantities it will allow the plants to grow and produce optimally.

4. Plant Dry Weight

The results of analysis of variance showed that the interaction of cow manure and atonic manure had a very significant effect on spinach dry weight. The average dry weight of spinach plants due to cow manure and atonic manure can be seen in table 4.

Table 4 Average dry weight of spinach plants due to cow manure and atonic application (gr)

Factor K	Factor A			Average
	A1	A2	A3	
K1	19.0 a	24 b	24.5 bc	7.500
K2	25 c	26 d	28 e	8.778
K3	29.5 f	31 g	34 h	10.500
Average	6.125	6.750	7.208	6.694

Note: The numbers followed by the same letter in the same column are not significantly different in the Duncan test (5%).

The Duncan test results (5%) showed that the highest dry weight of spinach was in the K3A3 treatment (20 tha^{-1} cow manure is equivalent to 6 kg plot⁻¹ and atonic concentration of 4 cc liters of water⁻¹) and significantly different from other treatments. This is because the interaction of organic cow manure and atonic manure is able to interact well in supplying nutrients and growth hormones. Cow manure contains macro and micro nutrients in a complete and balanced manner so as to increase photosynthetic activity. Furthermore, atonic will maximize nutrient and water uptake. Uptake has a strong correlation with crop stover weight. The higher the plant nutrient uptake, the higher the plant stover weight (Hartatik, 1992).

The addition of manure can improve the physical and biological properties of the soil so that it allows plants to absorb nutrients optimally for their growth and development. Gardner *et al.* (1991), fertilizing in the deficient zone will increase the dry weight of the plant, whereas fertilization in the excessive zone will result in an increase in the content of certain nutrients in plant tissue. If this happens, fertilization efficiency will not be achieved, thereby increasing absorption. The lowest dry weight of spinach stover was on K1A1 treatment and significantly different from other treatments. This is thought to be due to insufficient nutrients in the soil, thus inhibiting the process of plant growth and development. Arifin *et al.* (2010), states that nutrient deficiency can lead to inhibition of cell growth which causes plant weight to decrease.

Conclusion

Based on the results and discussion, several conclusions can be drawn, namely: Application of cow and atonic manure to spinach on dry land has a very significant effect on plant height, number of leaves, fresh weight and dry weight.

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