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Growth and Tomato Nutrition Content with Bandotan (*Ageratum Conyzoides* L) Bokashi Applied

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Abstract. Bandotan (*A.conyzoides*) is one of the most common weeds in dry land. Weeds can reduce the results of a variety of crops. On the contrary, the use of this weed as the organic material would be able to increase the nutrient content of the soil. The problem is, the decomposition of this weed is naturally longer than the process in the form of Bokashi. This study aims to determine the effect of Bandotan applied in the form of Bokashi on growth and nutrient content of tomato plants. This study was an experimental study and completely randomized design was used with 5 treatments and 3 replications. The treatment were rate of bandotan bokashi those 100, 120, 140, 160 g / polybag and 0,6g NPK / polybag as a control. The research was conducted in the Screen House of Biology Department, Faculty of Mathematic and Sciences, Universitas Negeri Padang. Tomato growth observed was high, wet weight, biomass and weight of the fruit. While the nutritional quality of tomatoes was vitamin C and A. Data were analyzed using ANOVA and a further test DNMRT at 5% level. The results showed that bokhasi bandotan 120g / polybag give best effect to the weight of tomatoes. However, bandotan bokashi do not give effect to the high, wet weight, biomass, vitamin C and vitamin A of tomato. Bokashi bandotan can be utilized as a substitute for synthetic fertilizer NPK for tomato plants.

1. Introduction

No doubt that in its habitat, the plant will interact with a variety of abiotic and biotic factors. The form of interaction can be beneficial or harmful. Adverse interactions occur as a result of competition in utilizing the resources available in the environment. In addition, some plants also secrete a compound residues which can inhibit the growth of other plants.

Ageratum conyzoides is one of the plants that are potentially harmful plants. *A.conyzoides* including 15 large plant pests in Southeast Asia [1]. *A.conyzoides* is one of the most important weeds found on agricultural land in Indonesia [2]. The amount of the main crop yield loss due to weed competition varies according to the type of plant. *A.Conyzoides* significantly affect the growth and yield curly chilli [3] Loss of grain yield of rice plants because of infestations of *A. conyzoides* ranged from 25-47% and 13-38% in the straw [4].

Harmful of *A. conyzoides* not only due to competition interspesies, but a chemical compound that is produced and released into the environment is also unfavorable plant main crops. *A. conyzoides* contains chemical compounds known as alelopati [5]. Residues generated by toxic weeds can be derived from the root exudation or excretion, volatilasi leaf through the stomata, or leaching from

fresh leaves by rain or dew, late of the litter that has been decomposed, and the transformation of soil microorganisms [6]. Extract of *A. conyzoides* can suppress weed growth and yield of tomato plants. Giving fluids *A. conyzoides* leaf juice at a concentration of 100 g / l is already able to inhibit the germination of mustard. Even at a concentration of 500 g / l was able to inhibit the germination of 100% [7]. Inhibition also occurs in plant height, leaf number and dry weight of mustard [8].

Although *A.Conyzoides* can reduce main crops as a result of competition or because they contain residues, but herbaceous plants also potentially be used as a source of plant nutrients. *A.conyzoides* containing organic carbon 42.11%, total N 3.78% and P 0.21% with the C / N ratio of 11.15. The nutrient content of the essential nutrients that are needed by the plant growth and development. *A.conyzoides* can be utilized in the form of organic matter or compost [9]. Application *A.conyzoides* embedded into the ground can significantly increase the number of leaves and dry weight of upland rice plants at the age of 9 weeks after planting [10]. Mulching bandotan (*A conyzoides* L.) 300 g / polybag significantly increased plant height, number of leguminous crops, and no significant effect on weed dry weight and plant dry weight green beans [11]. Application *A.conyzoides* on three types of plants in the form of compost higher influence on plant height, basal area, productivity and biomass allocation shoots than in the form of mulch. It is thought to relate to the contribution of nutrients provided in the form of compost is higher than the administration in the form of mulch [12].

Various studies indicate that application of organic material effect on plant growth after administration of over 8 weeks. This was caused, organic materials need sufficient time for decomposition. The release of nutrients in the decomposition of roots *A. conyzoides* at the initial stage more slowly than the next stage [13]. The length of time depends on the type of decomposition of organic materials used. Lignin and cellulose negatively correlated with the initial decomposition rate coefficient significantly. In contrast, the N concentration was positively correlated with the rate of decomposition coefficients. Microbial populations and diversity of fungi vary during the period of decomposition in the field and mainly depends on the nutrient content of the waste. The diversity of fungal species on the decomposition of roots A. *conyzoides* lower than in the leaves. Thus, mulching leaves would be more profitable than with plant roots

Based on the above it is known that *A.conyzoides* on the one hand able to inhibit the growth of other plants. Instead, the herbaceous plants are also able to increase the nutrient content of the soil, which in turn can be beneficial to the growth of staple crops. Giving *A.conyzoides* in a form that has been decomposed turned out better influence on plants, especially after a few weeks after planting. In order to accelerate the effect on plant growth it is necessary to attempt organic matter in the form of Bokashi. Bokashi is an organic fertilizer produced by the fermentation of organic materials. It contains both decomposed and undecomposed organic matter, microbial biomass, and the intermediate and ultimate substances produced by microbes during fermentation [14].

Application of bokhasi (*Tithonia diversifolia*) can increase the number of leaves, number of tillers per hill, plant height, number of plant roots, fresh weight and dry weight of onion crop [15]. Application bokhasi Gliricidia (*Gliriciadia sepium* (jacq.) Kunth) can increase the growth of cocoa seedlings especially number of leaves, seedling height, stem diameter, wet weight and dry weight [16]. Meanwhile application of *lamtoro* bokhasi can increase the weight of the fruit of tomatoes [17]. This study aimed to determine the effect of bandotan Bokashi on growth and tomato nutrition content

2. Research Methods

The research was conducted in screen house and plant physiology of biology department, Universitas Negeri Padang. The experiment arranged in completely randomized design with five treatment and three replications. The treatments were 0,6 g NPK, 100 g, 120 g, 140 and 160 g bandotan bokashi per polybag. Planting media used is garden soil. The dry garden soil was crushed and sieved using a 5 mm sieve. Put 6 kg of soil into polybags with diameter 35x40 cm [16]. The seeds of the savior varieties F1 soaked for 1x24 hours. The seeds are then grown in polybags in the nursery polybags and covered with thin soil. After reaching 30 cm high, the seedlings are ready for transplanting [18]. Bokashi bandotan is made by mixing 500 g of bran, 2 kg husk, 4 kg *bandotan*, 3 liters of sugar water with 1

percent concentration and 200 ml EM4. All material is stirred until homogeneous. Make sure the material has a water content of 30-40%. Put the mixture into the sack, cover and incubate for seven days. Maintain material temperatures between 30-50 ° C. After seven days, bokashi bandotan is ready for treatment [19]. Seed tomato transplanting to polybags by making a hole in the ground as deep as 10-15cm [20]. One week after planting the plant is given an stake to help the plant grow upright and reduce the physical damage of plants, wind blow and facilitate the plant mentanaince [21]. Bokhasi given one week before planting in accordance with the dose of treatment. Bokashi is given 5 cm around the stem. [16]. Watering is done twice a day in the morning and afternoon. Weeding done from planting until before harvest by removing weeds that grow around the plant . Observations were made on plant height, plant wet weight, fruit weight, biomass, vitamin and vitamin A [22]). The data obtained were analyzed by Analysis of variance and further test with DNMRT at 5% level [23].

3. Results and discussion

3.1. High Tomato Plant

The results showed that the bokashi dose did not show a linear correlation with plant height. Application of bokashi with a dose of 100 g showed the same effect with the control of NPK fertilizer. Increasing the dose of bokashi to 120 g actually resulted in reduced plant height. Even if the dose is increased to 140, the plant height is significantly reduced compared to the 100 gram bokashi dose (Table 1). Thus it can be seen that the application of bokashi can replace the role of NPK synthetic fertilizer. Increased plant height is associated with organic compounds application. Organic compounds derived from bandotan are decomposed by microorganisms contained in EM4.) Microorganisms on EM4 can ferment organic materials into anorganic, sugars, alcohols, amino acids and various biogenic substances that can be absorbed directly by the roots of plants to acelerates the growth and development of plant [25]. This is related to the needs of plants on macro nutrients in the form of N, P and K. Nutrition needs of these nutrients can be met from the source of organic materials used as a bokashi materials. A.conyzoides contained total N, 3.78% and P total of 0.21% [9].

Table 1. Effect of *bandotan* bokhasi on tomato plant height (8 weeks)

Treatment	High plant average (cm)
A. 0,6 g NPK	94,56 c
B. 100g	90,90 bc
C. 120g	85,67 ab
D. 140 g	80,87 a
E. 160 g	79,80 a

The numbers followed by the same letters show no significant difference at the 5% level by DNMRT

Nitrogen is an essential element required for successful plant growth [21]. NPK fertilizer contains high nitrogen, which is 15% in the form of NH3 [26]. Nitrogen-deficient plants had significant lower leaf nitrogen and chlorophyll a contents. They also showed a significant reduction in their photosynthetic capacity [28]. Plant height pepper was were influenced by N fertilizer [29]. Therefore, it can increase the growth of plant height. Whereas *bandotan* bokhasi contains only 6.3% nitrogen [30], so the high growth of tomatoes tends to be low. However, the height of the plants on the controls gives no significant effect compared with 100 g bokhasi applications.

Plant growth is related to the activity of apical meristematic cells. When cell division in the meristematic region takes place, the tip moves upward, leaving the cells formed by the division. These cells then increase in size so that it becomes a part of the elongation area that slowly occurs differentiation and maturation. As a result of this activity, growth becomes faster and plant height may increase during the growing season [31]. The application of organic matter increases the height of tomato plants at the age of 4 and 8 weeks [32].

3.2. Wet Weight Tomato Plant.

The wet weight of the tomato plant ranges from 71.3 on the treatment of 160 g bokashi to 85.8 on the 100g bokashi treatment. Nevertheless, the application of bokashi did not have a significant effect on the wet weight of plant crops. The average wet weight of tomato plants can be seen in Table 2.

Table 2. Effect of bandotan bokhasi on wet weight of tomato plants

Treatment	Wet weight plant (g)
B. 100 g bokhasi	85,8
C .120g bokhasi	83,6
D .140g bokhasi	73,3
A .0,6 g NPK	71,5
E .160g bokhasi	71,3

The wet weight indicates the moisture present in the plant (28). The wet weight of the plant is a reflection of the water content and nutrient composition of the plant tissue. Absorption of nutrients and water by plants is crucial to the success of plants to grow (32). Although not showing significant differences, the dosage of bokhasi is directly proportional to the wet weight of the plant. The higher the dose given the greater the wet weight of the plant. This is thought to be related to the soil's ability to absorb water. One of the advantages of organic fertilizer is its ability to absorb water higher than inorganic fertilizer. The availability of sufficient water results in increased nutrient solubility, so that the availability for the plant is also increasing. This is what causes the growth of plants to be better. Soil that contains enough water, then the roots of plants will grow well, so that it will affect the nutrients, which in turn increase the wet weight of plant (33). Another thing that causes no significant effect of doses on wet weight of tomato plants is the need of nutrients is sufficient. Thus, increasing doses will not have a significant effect on wet weight. The wet weight of the plant is affected by genetic and environmental interactions. Environmental factors that affect are the elements of nutrients, water and light.

3.3. Weight Fruit

Bandotan bokhasi application affects the weight of tomatoes. An increase in dosage from 100 g to 140 is directly proportional to the weight of tomatoes. An increase in bokhasi dose exceeding 140 did not have a significant effect on the weight of fruit (Table 3)

Table 3. Effect of bandotan bokhasi on the weight of fruit

Treatment	Fruit weight average (g)
D. 140g	2,2 b
C. 120g	2,19 b
E. 160g	2,06 ab
B. 100g	1,99 a
A.0,6g NPK	1,98 a

The numbers followed by the same letters show no significant difference a the 5% level by DNMRT

Based on the data in Table 3, it appears that bokhasi applications exceeding 100 g can replace the role of NPK fertilizer. Conversely, an increase in doses exceeding 140 actually leads to a decrease in the weight of the fruit and gives the same yield as NPK. This happens because the decomposition of organic material not only supplies macro nutrients, but also micro nutrient elements are needed in metabolism. In addition, bandotan bokhasi has advantages in improving soil structure, increasing humus and stimulating the life of soil microorganisms (34). Microorganisms that live in the soil increase the growth and production of plants, because of their role in fixing N2 from the air and converting ammonium to nitrate (35). The availability of organic compounds, good soil structure, high

humus and life of soil microorganisms contained in bandotan bokhasi this is causing the increase of fruit weight.

3.4. Tomato Plant Biomass

The highest biomass of plants was obtained at 100g and the lowest dose of 120g bokhasi. Bokashi application proved to replace the role of NPK. Nevertheless, a dose increase of up to 160 g of bokashi has not been able to increase the biomass of plants (Table 4). Biomass in the form of dry weight of plants reflects the accumulation of organic compounds, water and carbon dioxide. Total biomass olive was strongly reduced under nitrogen deficiency [28]. The nutrients at the root will be used for synthesis of organic compounds and which contribute to the increase of dry weight of plants [33]. Bokhasi applications are able to change the soil chemical properties for the better, especially the increased availability of phosphorus. The higher the phosphorus uptake by plant roots the higher the plant biomass [36]. Phosphorus is also important for cell division and enlargement, thus plant growth is reduced when the supply of P is too low [37].

Table 4. The influence of bandotan bokhasi on tomato plant biomass

Treament	Biomass (g)
B. 100g	11,7
E. 160 g	10,4
A. 0,6g NPK	9,43
D. 140g	9,36
C. 120g	9,33

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3.5. Vitamin C

The highest application of botanical fertilizer was obtained at a dose of 160g and the lowest at 100g treatment. Nevertheless, the results show that bokashi or NPK applications do not affect the vitamin C content (Table 5)

Table 5. Effect of bandotan bokhasi on vitamin C tomato content

Treatment	vitamin C content (%)
E . 160g	0,84
C . 120g	0,82
D . 140g	0,71
A . 0,6g NPK	0,69
B . 100g	0,56

Vitamin C is a water-soluble white crystal that has many benefits for humans [38]. Bandotan bokhasi application has no significant effect on tomato vitamin C levels. Vitamin C is influenced by genetic and environment including nutrients and pH of planting medium. Nutrients that play a role in the formation of vitamin C is manganese (Mn). Manganese required by the plant for the formation of proteins and vitamins especially vitamin C. The availability of manganese for the plant depends on soil pH. Availability of Mn is low at neutral to alkaline pH [39]. There was no significant difference in vitamin C content among treated plants pepper with different nitrogen levels at mature stage [27]. Vitamin C content in tomato was not confirmed by the application of vermicompost and chemical fertilizers. (40) Potassium rates supplied to the tomato plant did not affect the vitamin C concentration in the fruits [41]. This is why the bokhasi application does not affect the levels of vitamin C tomatoes.

3.6. Vitamin A

The content of vitamin A tomatoes ranged between 0.60 at a dose of 140 g bokhasi to 1.11 at a treatment of 160 g. Although bokhasi doses do not significantly affect vitamin A content, bokashi applications may replace the role of NPK fertilizers (Table 6).

Table 6. Effect of bokhasi bandotan on vitamin A tomato content

Treatment	vitamin A content (ppm)
E. 160 g	1,11
B . 100g	1,08
A . 0,6g NPK	0,78
C . 120g	0,73
D. 140g	0,60

No significant effect of bokashi dose on vitamin A content is thought to be related to nutrients needed for vitamin formation. Elements that play a role in the formation of vitamin A is copper (Cu). Copper plays an important role in carbohydrate catabolism an enzyme activator in the process of storing food reserves and is one of the elements in the formation of vitamin A which indirectly play a role in the formation of chlorophyll [21]. An increase in dose of up to 160 g is not sufficient to improve the vitamin A synthesis. It can also be observed in NPK fertilizer applications that do not contain Cu elements. Thus, the role of bokashi is only limited as a substitute for NPK synthetic fertilizers and has not been able to increase the content of vitamin A.

4. Conclusion

Bokashi *bandotan* can be used as a substitute for NPK chemical fertilizer in tomato plants. Bokashi application gives the same or higher result compared with NPK fertilizer. The application of bokashi can increase the height and weight of tomato fruit. In contrast, bokashi application has not been able to increase the content of vitamin C and A in tomato plants.

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