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Research Article

BAP Responses to the Flowering and Production on Red Onion Varieties

Fatiani Manik[1*], Endah Retno Palupi[2], dan Mohamad Rahmad Suhartanto[2]

[1]Kebun Percobaan Berastagi, Balai Penelitian Tanaman Sayuran, Jl. Raya Medan-Berastagi Km. 60 Sumatera Utara

[2]Departemen Agronomi dan Hortikultura, Fakultas Pertanian, Institut Pertanian Bogor (Bogor Agricultural University), Jl. Meranti, Kampus IPB Dramaga, Bogor

Abstract

The use of TSS as a seed has many advantages over grasses, including healthier plants and higher productivity. This study aimed to find out the response of three varieties of onion (Bima, Bauji and Sumenep) to the provision of BAP to enhance TSS production. The research was conducted at Leuw Bishop Experiment Station (240 m above sea level) and the Department of Agriculture and Horticulture Science Department of Seed Science and Technology, Bogor Agricultural Institute from March to December 2015. The experiment was conducted in a two-factor randomized design (RAK). The first factor is the BAP concentration consisting of five standards; 0, 50, 100, 150 and 200 ppm. The second factor is the varieties consisting of Bima, Bauji and Sumenep. The two-factor combination of the 15 treatment combinations was repeated three times so that there were 45 units of trials. Each experiment consisted of 30 plants and 10 plants were observed as samples. The results show that the 50 ppm BAP Application can increase the flowering percentage by 38.3%. Salad varieties produce the highest number of capsules per bag (53.8 capsules) compared to Bima (39.1 capsules). The highest TSS weight per straw and per plot was also produced by the Salad varieties (0.456 g and 6.179 g, respectively). The Ranger varieties have a weight of 1000 grains weighing 3.652 g than the Gross 3.557 g. BAP application up to 200 ppm is unable to stimulate the flowering of the Sumenep varieties of onions that are difficult to flower.

Keywords: Onions, benzylaminopurins, varieties, botanical seeds, seed quality

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Corresponding Author: Fatiani Manik, Kebun Percobaan Berastagi, Balai Penelitian Tanaman Sayuran Jl. Raya Medan-Berastagi Km. 60 Sumatera Utara

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Introduction

Quality seeds are one of the important factors in increasing the productivity of shallots. In general, shallots are produced with tubers as planting material or as a source of seeds. The use of onion seeds usually comes from tubers for consumption or imported seeds. The scarcity of seeds is due to the nature of seasonal onion production and short shelf life. According to Hilman et al. (2014) scarcity of seeds occurs because farmers tend to sell seeds that have been set aside for the next planting season when the price of shallots on the market tends to rise. Therefore, to overcome the scarcity of tuber seeds, quality onion seeds have been developed, namely botanical seeds or true shallot seeds (TSS).

The use of TSS as a seed can increase crop productivity, free from seed-borne diseases, a longer shelf life, and does not require a large space (Sumarni et al. 2005). In addition, TSS can increase yields by up to two times and net income between 22-70 million rupiahs compared to traditional tuber seeds (Basuki 2009).

TSS cultivation has been developed since the 1990s through several studies. Sumarni & Sutiarso (1998) obtained the highest TSS production in the Bima variety of 0.34 g / plant from the treatment of a combination of tuber seed size >5 g during the dry season planting in the Majalengka medium plain; Rosliani et al. (2012) obtained TSS production in the Bima variety in the highlands as much as 1.02 g / plant through the administration of 100 ppm BAP, and 1.05 g / plant through the application of 3 kg ha-1 boron; Sumarni et al. (2013) obtained TSS production in the Pancasona variety in the highlands of 205.66 g / 12 m2 or equivalent to 137.11 kg/ha through the application of GA3 by immersion for 30 minutes in a 200 ppm GA3 solution. Rosliani et al. (2013) obtained TSS production in the Bima variety in the lowlands as much as 0.52 g / plant through the administration of 50 ppm BAP.

Shopa et al. (2014) stated that TSS production in the Bali Karet cultivar with a 16-hour photoperiod increased TSS seed production from 0.48 g / plant to 1.30 g / plant while administering 200 ppm GA3 was able to increase TSS production from 0.53 g / plant to 0.70 g / plant. Hilman et al. (2014) stated that TSS production in the highlands is higher (2.58 g / plant) than in the lowlands (0.35 g / plant) but the quality of TSS in the lowlands is better than in the highlands.

According to Palupi et al. (2015), the introduction of Apis cerana dugouts increased TSS production in the lowlands from 0.31 g / plant to 0.50 g / plant and in the highlands increased from 0.88 g / plant to 1.38 g / plant. Meanwhile, Kurniasari et al, (2017) stated that BAP concentrations of 50 ppm given at 2, 4, and 6 weeks after planting (MST) and the introduction of Apis cerana around plantations could increase TSS production in Bima varieties in the lowlands of 0.06 g / plants to 0.26 g / plant.

In general, Bima varieties are selected by farmers for cultivation of TSS production because of their flowering character. Therefore, the technique can be applied to other varieties with different flowering rates. In general, not all varieties of shallots in Indonesia are easy to flower naturally. Some onion varieties that are able to flower naturally are Yellow varieties, easily flowering is Bauji, slightly difficult to flower is Bima and difficult to flower is Sumenep (Satjadipura 1990). Based on these problems, research to increase TSS production in varieties that have different flowering ability is very necessary. The purpose of this study is to determine the effect of BAP concentrations and varieties in increasing the production and quality of TSS onions.

Materials and Methods

Time and Place of Research

The study was conducted from March to November 2015 in the Leuwikopo Experimental Garden (240 m asl) in the Seed Science and Technology Laboratory of the Department of Agronomy and Horticulture, Bogor Agricultural University.

Plants

Shallot bulbs, Bima varieties from the Indonesian Vegetable Research Institute (Balitsa), Bauji and Sumenep varieties from the Center for Tropical Horticulture Studies (PKHT). Tuber seeds are uniform in size, stiff and are not attacked by the disease. Another ingredient, Benzylaminopurin (BAP).

Experimental design

The experiment used a two-factor randomized block design (RCBD). The first factor is the variation in BAP concentration; 0, 50, 100, 150 and 200 ppm. The second factor is variety variation; Bima, Bauji, and Sumenep. The combination of the two factors is 15 treatment combinations with three replications, a total of 45 experimental units. Each experimental unit consisted of 30 plants and 10 plants were used as samples.

Research Implementation

Shallot bulb varieties; Bima, Bauji, and Sumenep were vernalized at 10°C for 4 weeks. Shallots are planted in polybags containing 8 kg of planting media in the form of a mixture of soil, goat manure and husk charcoal (3: 2: 1), plus 1-ton ha-1 dolomite. The media is placed in 40 cm x 45 cm polybags. Each polybag was planted with three tubers with a spacing of 20 cm between the bulbs. Polybags are placed on beds and covered with clear UV plastic with a thickness of 1 mm. The plastic cover is made when the plant is 3 weeks after planting (MST). Fertilization is done once a week using NPK (16:16:16) at a dose of 1 g per polybag (equivalent to 600 kg ha-1) dissolved in 100 mL of water. Fertilizer solution is applied every week from the age of 1 MST to 10 MST. BAP is given three times at the ages of 2, 4, 6 MST with the appropriate concentration of treatment. BAP application is done by watering at the apical growing point as much as 100 mL/polybag. Pest and disease control is done by administering insecticides and fungicides. The physiological quality test of the seeds is carried out using paper in a petri dish, then the seeds are germinated in the standard germinator of the Seedburo Equipment at 25 ° C. Each treatment consisted of 4 replications and each test consisted of 25 seeds.

Variables

The variables to be observed are the growth, flowering, production, and quality of TSS. Growth observation: plant height measured at 1, 2, 3, 4, 5 and 6 MST measured from the surface of the soil to the longest leaf tip, number of leaves counted at 1, 2, 3, 4, 5 and 6 MST. Flowering Observation: the percentage of flowering plants calculated based on the number of flowering plants in the experimental unit. The number of umbels / plants, which is the average number of umbels / one plant. The number of flowers / umbels, that is the average number of flowers in one umbel. The number of capsules is calculated from the number of capsules in one umbel. Observation of TSS Production: number of TSS / umbel, average number of TSS / one umbel, weight of the TSS / umbel, TSS / plant and TSS / plot (g). Observation of TSS quality: Weight of 1000 items; calculated from the average weight of 100 pure seeds 8 times (8 replications). Then the average of 8 replications is multiplied by 10. The germination (DB) is calculated based on the number of normal germination (KN) in observation I (day 6) and observation II (day 12). The formula for germination calculation is the number of normal sprouts (KN) count I plus the number of normal sprouts (KN) count II divided by the number of seeds planted multiplied by a percent. Vigor Index (IV), calculates the percentage of normal germination (KN) at the count of 1 (day 6). The vigor index is calculated by the number of normal sprouts in the first count divided by the number of seeds planted multiplied by one hundred percent. Maximum Growth Potential (PTM) by calculating the percentage of normal and abnormal sprouts that appear until the 12th day of observation. The maximum growth potential is calculated from the number of germinated seeds divided by the number of seeds planted and multiplied by one hundred percent.

Data Analysis

The effect of the treatment was analyzed with the SAS (statistical analysis system) program and further testing with the multiple range test (DMRT) at $\alpha = 5\%$.

Results and Discussion

Vegetative Growth

The analysis showed that there was no interaction between BAP application and seed varieties on vegetative growth, flowering, TSS production, and TSS quality. The increase in leaf number and plant height was not caused by BAP application, but by seed varieties (Table 1).

Variations in BAP concentrations of 50, 100, 150 and 200 ppm per plant did not affect the increase in the number of leaves and plant height. The average number of leaves produced after BAP was 22.1 strands, while the average plant height was 26.8 cm.

The Bima variety has the highest number of leaves and plant height followed by Bauji and Sumenep varieties. At 42 HST the number of leaves in the Bima variety reached 25.2 strands, Bauji 22.8 strands, and Sumenep 18.3 strands. While the height of the Bima variety is 32.2 cm, Bauji 26.2 cm, and Sumenep 22.2 cm. This indicates that the number of leaves and plant height are influenced by genetic factors in each variety. Different varieties or plant clones can affect the diversity of leaf numbers and plant height and are inherited to the next generation (Putrasamedja 2010, 2011, Putrasamedja et al. 2012, Azmi 2011, Sinaga et al. 2013, Kusuma 2013, Deden 2014).

Table 1. Effect of BAP and seed varieties on the number of leaves and plant height at 42 days after planting (HST)

Application	Number of Leaves (helai)	Plant Height (cm)
BAP Concentration (ppm)		
0	21.7	26.7
50	22.0	26.4
100	23.1	27.5
150	21.5	26.8
200	22.3	26.8
Mean	22.1	26.8
Varietas		
Bima	25.2 a	32.2 a
Bauji	22.8 b	26.2 b
Sumenep	18.3 c	22.2 c
Mean	-	-
BAP x Variety	tn	tn
KK (%)	10.5	5.0

Note: Numbers with the same letter in the same column indicate no significant difference based on the DMRT test at the level of α = 5%, tn: not significantly different

Flowering Plants

BAP application affects the percentage of flowering plants but does not affect the number of umbel / plants, number of flowers/umbel and number of capsules / umbels. Meanwhile, seed varieties influence the observed flowering parameters (Table 2).

method of soaking tubers for onion for 80 minutes has not been able to initiate flowering in Sumenep varieties.

Table 2. Effects of BAP and seed varieties on the percentage of flowering plants, number of umbles/plants, number of flowers/umbles, and the number of capsules/umbles

Application	Flowering Plant (%)	Numberof Seed/ Umbel	Number of Flower/umbel	Number of Capsule/umbel
BAP Concentration (ppm)				
0	21.4 b	1.1	67.4	41.8
50	38.3 a	1.3	75.9	44.7
100	37.2 a	1.3	66.6	38.1
150	33.9 a	1.5	100.6	59.5
200	37.7 a	1.6	83.5	48.2
Mean	-	1.3	131.3	46.4
Variety				
Bima	32.5 a	1.4 a	74.4 a	39.1 b
Bauji	34.9 a	1.3 a	83.2 a	53.8 a
Sumenep	0 b	0 b	0 b	0 c
Mean	-	-	-	-
BAP x Varietas	tn	tn	tn	tn
KK (%)	16.2	10.8	17.3	17.3

Note: Numbers with the same letter in the same column indicate no significant difference based on the DMRT test at the level of α = 5%, tn: not significantly different

Bauji varieties produce 34.9% flowering plants with the number of umbles/plants 1.3 and the number of flowers / umbles 83.2. While flowering plants in the Bima variety is 32.5%, the number of umbel / plants 1.4 and the number of flowers/umbels 74.4. The highest number of capsules / umbles produced by Bauji varieties is 53.8. A positive relationship is indicated between the number of flowers/umbles and the number of capsules / umbles (r = 0.81). This concludes that increasing the number of flowers / umbles increases the chance of the formation of the number of capsules/umbles with a proportion of 0.81.

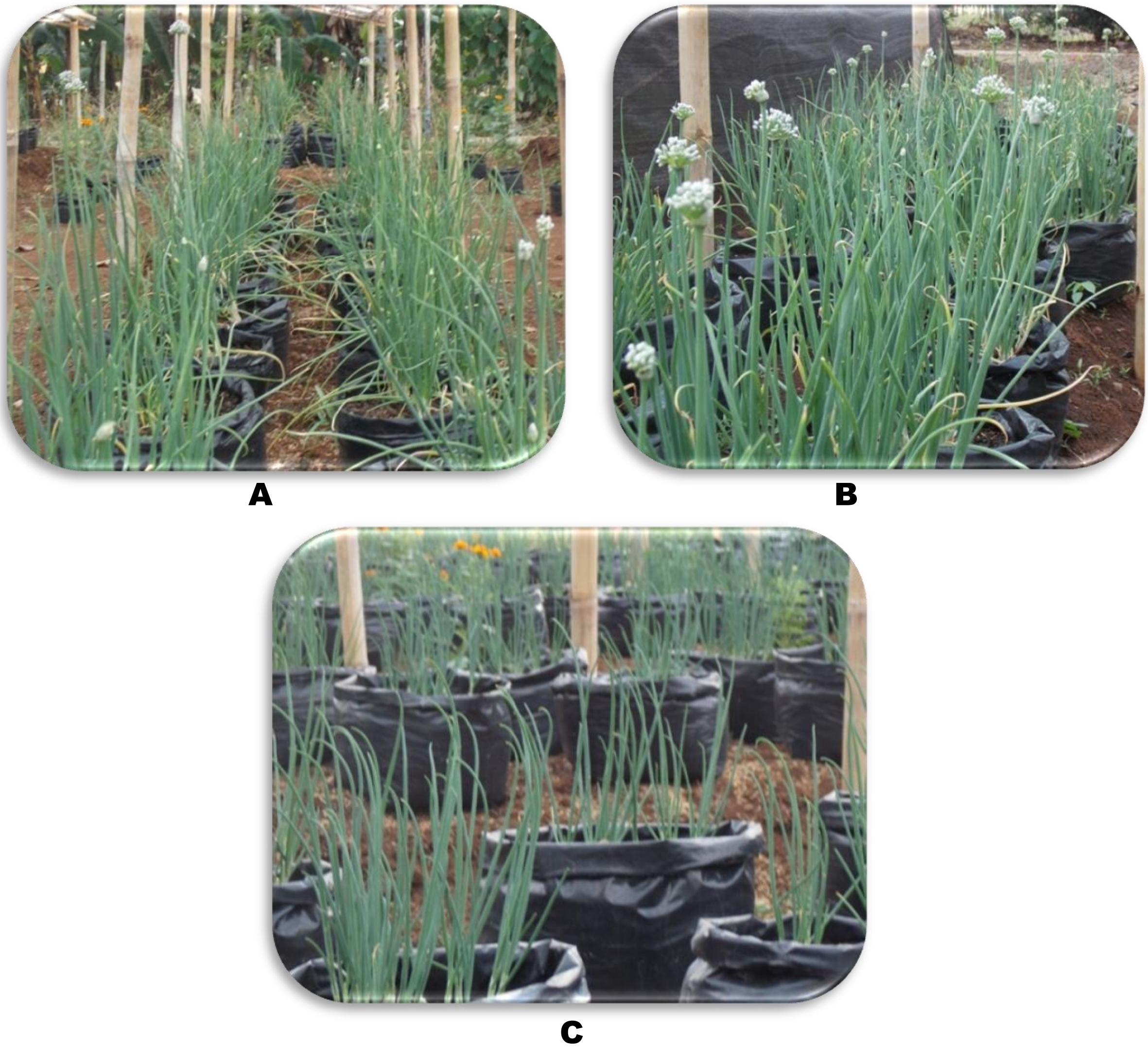

Figure 1. Bima (A), Bauji (B) and Sumenep (C) varieties of onion

The BAP with a concentration of 50 ppm showed the highest percentage of flowering plants 38.3% compared with no BAP treatment as much as 21.4%. Rosliani et al. (2013) concluded that the use of BAP 50 ppm in Bima varieties in the Subang lowlands with an application time of 1, 3 and 5 MST increased flowering from 11.7% to 28.9%. Kurniasari et al. (2017) concluded the application of 50 ppm BAP in Bima varieties in Subang at 2, 4 and 6 MST increased flowering from 27.8% to 38.9%. This indicates that the application of BAP is consistent with increased flowering on vernalization onions. Vernalisation causes flower initiation, while BAP application increases induction so that the percentage of flowering plants is higher.

The BAP application has no effect on the number of tubers/plants, the number of flowers/umbles, and the number of capsules/umbles (Table 2). The highest number of tubers/plants is 1.6 at a concentration of 200 ppm and the lowest is without BAP treatment is 1.1. The highest number of flowers/umbles and capsules/umbles in the BAP treatment at a concentration of 150 ppm followed by 200 ppm, 50 ppm, 0 and 100 ppm.

Plants that produce a lot of flowers are Bauji varieties followed by Bima varieties without BAP. Meanwhile, the Sumenep variety did not flower even with a BAP concentration of 200 ppm (Figure 1). This finding is in accordance with the results of Putrasamedja and Permadi (2004), namely that the administration of GA3 up to a concentration of 40 ppm, with theBased on the flowering ability of the 3 varieties tested, the three varieties can be classified into 3 characteristics, namely: Bauji varieties are easy to flower, Bima varieties are rather difficult to flower and Sumenep varieties are difficult to flower although BAP is applied up to 200 ppm. This finding is similar to the research of Satjadipura (1990) that the Sumenep variety has difficult flowering characteristics. Therefore, the rate of flowering can be influenced by genetic factors.

TSS production

BAP application does not affect the number of TSS / umbel, the weight of TSS / umbel, weight of TSS / plant and weight of TSS / plot (Table 3). The average number of TSS / umbles was 156.9 units, weight of TSS / umbles was 0.409 g and the weight of TSS / plants was 0.563 g. While the highest average TSS / plot weights were 4,750 g because of the high number of TSS / umbles.

The results of this study are higher than those of Rosliani et al. (2013) with an average number of TSS / umbles produced by 75.5 units, the weight of TSS / umbles 0.323 g and weight of TSS / plants 0.432 g. Kurniasari et al. (2017) obtained an average number of TSS / umbles of 88.5 units, weight of TSS / umbles of 0.302 g and weight of TSS / plants of 0.365 g.

Bauji varieties showed higher TSS / umbel weights and TSS / plot weights compared to Bima varieties. The number of TSS / umbel and weight of TSS / plants in the Bima and Bauji varieties were not significantly different. Meanwhile, the Sumenep variety did not produce TSS because it was unable to flower (Table 3). The high TSS weight/plot produced by the Bauji variety was significantly correlated positively with the number of capsules (r = 0.90) and TSS / umbel production (r = 0.80). Sumarni and Soetiarso (1998) concluded that the level of onion seed production depends on the high percentage of plants for flowering, the ability of insects as pollinators and environmental support for seed development. Palupi et al. (2015) concluded that the formation of capsules and the weight of pithy seeds produced at cross-pollination was higher than that of self-pollination. Palupi et al. (2017) and Kurniasari et al. (2017) also agreed that the percentage of pithy capsules and increased TSS production was influenced by pollinating insects that help cross-pollination.

Table 3 Effect of BAP and varieties on the number of TSS / umbles, the weight of TSS / umbles, weight of TSS / plants, and weight of TSS / plots

Application	Number of TSS/Seed	Weight of of TSS/Seed (g)	Weight of TSS/Plant (g)	Weight of TSS/Plot (g)
BAP Concentration (ppm)				
0	138.3	0.422	0.495	3.090
50	159.7	0.430	0.566	5.592
100	144.6	0.387	0.551	3.782
150	191.4	0.421	0.661	6.003
200	150.6	0.388	0.545	5.285
Mean	156.9	0.409	0.563	4.750
Varietas				
Bima	138.9 a	0.363 b	0.509 a	3.321 b
Bauji	174.9 a	0.456 a	0.618 a	6.179 a
Sumenep	0 b	0 c	0 b	0 c
Mean	-	-	-	-
BAP x Variety	tn	tn	tn	tn
KK (%)	16.4	3	5.8	22.7

Note: Numbers with the same letter in the same column indicate no significant difference based on the DMRT test at the level of α = 5%, tn: not significantly different

TSS Quality

Variation in BAP concentration that was applied did not affect the weight of 1000 seed grains but affected the seed vigor index, germination capacity and maximum growth potential. Seed varieties affect the weight of 1000 seed grains, vigor index, germination capacity and maximum growth potential (Table 4).

Table 4. Effect of BAP and varieties on the weight of 1000 seeds, vigor index (IV), germination (DB) and maximum growth potential (PTM)

Application	Weight of 1000 seeds (g)	IV (%)	DB (%)	PTM (%)
BAP Concentration (ppm)				
0	3.618	76.5 a	84.0 a	91.0 ab
50	3.643	80.5 a	85.0 a	93.0 a
100	3.556	67.0 ab	80.5 ab	88.0 ab
150	3.587	60.0 bc	75.0 ab	85.5 b
200	3.618	52.5 c	72.5 b	90.5 ab
Mean	3.604	-	-	-
Varietas				
Bima	3.652 a	70.8 a	77.2a	84.0 b
Bauji	3.557 b	63.8 a	81.2 a	95.2 a
Sumenep	0 c	0 b	0 b	0 c
Mean	-	-	-	-
BAP x Varietas	tn	tn	tn	tn
KK (%)	4.2	19.4	12.2	6.6

Note: Numbers with the same letter in the same column indicate no significant difference based on the DMRT test at the level of α = 5%, tn: not significantly different

The difference in BAP concentration affects the vigor index, germination capacity, and maximum growth potential of the seed. The vigor index and germination capacity of the control (BAP 0 ppm) were not significantly different from the 50 ppm BAP treatment, 80.5%, and 85%, respectively. But there was a decrease in seed quality at higher BAP concentrations of 100-200 ppm where the vigor index was lower (52.5% - 67.0%) followed by a low germination rate (72.5% - 80.5%). Similar results were observed in Kurniasari et al. (2017) that the addition of BAP concentrations of 100-250 ppm resulted in a decrease in germination capacity of 22% - 43.5%. Meanwhile, BAP at a concentration of 50 ppm germinated higher at 64.5%. This shows that the higher the BAP concentration, the lower the quality of seeds.

Application of BAP 50 ppm is proven to be able to increase the maximum growth potential of seeds by 93%, very significantly different from BAP 150 ppm, the percentage only reaches 85.5% and significantly different from control (91.0%), 100 ppm (88.0%) and 200 ppm (90.5%). This shows the high viability of TSS products and good quality seeds.

The weight of 1000 seeds of Bima variety (3,652 g) is higher than that of Bauji (3,557 g). This shows that Bima seeds are bigger and heavier than Bauji seeds. The same thing was reported by Satjadipura (1990) which stated that the weight of seeds/plants of the Bima variety was heavier than the Yellow variety. Heavier seed weights are thought to be due to the thickness of the different seeds between Bima and Bauji. Wulandari et al. (2014) reported that anatomically, TSS of the Bima variety had thicker testa compared to Tuk-Tuk and Super Filipin varieties.

The percentage of vigor index and TSS germination of Bima and Bauji varieties were not significantly different. The Bima variety has a vigor index percentage of 70.8%, and Bauji of 63.8%. Then, the ability to germinate TSS Bima 77.2% and Bauji 81.2%. The maximum growth potential produced by Bauji varieties is 95.2%, higher than Bima with a maximum growth potential percentage of 84.0%. The results of the seed quality test showed that the high viability of Bima and Bauji varieties with a percentage above 75%, the minimum standard of quality shallots seeds (Directorate of Germination 2007).

Sumenep varieties cannot flower, do not produce seeds and there is no seed quality value. The zero-value found in the study results (Table 4) shows that no seeds were observed.

Conclusion

There was no interaction between BAP applications and varieties, on plant growth, flowering, TSS production, and onion seed quality. Application of 50 ppm BAP can increase the percentage of flowering up to 38.3%. Bauji varieties produce the highest number of capsules/umbles (53.8 capsules) compared to Bima (39.1 capsules). The highest TSS / umbel and / plot weights were also produced by Bauji varieties (0.456 g and 6.179 g). The weight of 1000 seeds of the Bima variety has a heavier weight of 3,652 g than that of Bauji 3,557 g. Application of BAP up to 200 ppm is not able to stimulate flowering of Sumenep varieties, due to the difficult flowering nature.

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