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THE AGRONOMIC PERFORMANCE OF SHALLOTS DUE TO THE TIME OF VERNALIZATION AND THE DOSE OF CHICKEN MANURE

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ABSTRACT

Vernalization of seeds and chicken manure doses can increase red tubers' yield. vernalization can accelerate flowering because tubers or shoots respond to flowering at low temperatures. Chicken manure has a relatively high P nutrient content and decomposes faster than other fertilizers. This study aimed to study the infection duration of vernalization with a dose of chicken manure on the growth and yield of shallots to determine the optimal vernalization time and dose of chicken manure using a two-factor randomized block design (RBD). The first factor is four stages of vernalization (V) four levels. v_0 = no vernalization (control), v_1 = 1 week, v_2 = 2 weeks, v_3 = 3 weeks. The second factor is four doses of chicken manure (K). k_0 = 0 t ha^{-1} (control), k_1 = 10 t ha^{-1}, k_2 = 20 t ha^{-1}, k_3 = 30 t ha^{-1}, 3 times. The experimental results showed an interaction between vernalization length and dose of chicken manure on plant height and number of leaves at 7 WAP, flowering age, wet tuber weight per plot, dry tuber weight per plot, and harvest index. The optimum vernalization time was 4.22 weeks, and the optimum dose of chicken manure was 5.03 t ha-1, resulting in the maximum dry weight of shallot bulbs 4.97 t ha^{-1}.

Keywords: vernalization, chicken manure, shallots

INTRODUCTION

Shallots are herbs, vegetables in the form of tubers, and medicinal plants of high economic value from the Alliaceae family (Atmaja et al., 2019; Askari-Khorasgani & Pessarakli, 2020; Bintua Simbolon et al., 2020; Rosliani et. al.., 2021, Muhardi, 2022). The need for more availability of quality seeds is a problem in increasing shallot production (Kurniasari et al., 2018). Seed technology is needed for high-quality seeds to be available throughout the year (Prahardini & Sudaryono, 2018).

Plant propagation through tubers has a high success rate and is easier and more practical. However, the production costs of these bulbs can reach 60% of the total cost of cultivating shallots (Elkawakib Sam'un, 2017). The continuous use of tubers decreases productivity much lower than its potential (Fahrianty et al., 2020). Regarding cultivation, vernalization treatment (seed tubers were stored at cold temperatures between -5 ^{0}C to 16 ^{0}C in a cold room) increased the production of shallots. The post-juvenile phase during storage or when grown in the field is influenced by the age of the seed. The age of the older seeds will require less cold induction. Temperature can affect the growth and morphogenesis of plant tubers naturally. The extended treatment of vernalization can increase the activity of auxin, gibberellins, and cell division. Vernalization is a way to accelerate plant flowering by pretreatment of seeds or plant seeds at low temperatures.

Low soil fertility is another factor causing the decline in shallot productivity (Wibowo et al., 2017). This is due to too much inorganic fertilizer, continuous planting without fallow, and soil compaction. Atman et al. (2021) suggested that the use of cow manure as much as 10 t ha^{-1} - 25 t ha^{-1} can increase the yield of shallot bulbs from seeds; chicken manure increases plant height, number of leaves, number of tubers per planting hole, plant fresh weight, and yield of shallot bulbs. According to Sulasmi et al. (2020), chicken manure with a dose of 10 t ha^{-1} produced the highest number of tubers, production per plant, and production per plot of shallots. Some of the results of previous studies stated that vernalization treatment in the highlands can increase flower formation. However, a description of the low-medium plains has not yet been found.

This study examines the interaction effect of vernalization and chicken manure on the growth and yield of shallots. It identifies the optimal vernalization time and chicken manure that achieves maximum results.

MATERIALS AND METHODS

The research was carried out from March 2019 to May 2019 at an altitude of 850 m above sea level at the Experimental Garden of the Faculty of Agriculture, Winaya Mukti University, Tanjungsari, Sumedang. The research method used is the experimental method. The experiment used a factorial Randomized Block Design (RAK) consisting of two factors. The first factor is the duration of the four levels of vernalization (V). v_0 = no vernalization (control), v_1 = 1 week, v_2 = 2 weeks, v_3 = 3 weeks, the second factor is chicken manure (K) at four levels, namely k_0 = 0 t ha^{-1} (control), k_1 = 10 t ha^{-1}, k_2 = 20 t ha^{-1}, k_3 = 30 t ha^{-1}, repeated three times. The materials used are red onion, chicken manure, cool storage or refrigerator with adjustable temperature, Furadan 3G, fungicide Dithane M-45 80 WP, and insecticide Curacron 40 WSC. The equipment used is a hoe, fork, knife, meter, bucket, emrat, stationery, scales, raffia thread, thick white plastic, and bamboo stakes.

The medium-sized seeds of the Bima variety (± 20 g /grain) shall be put in a plastic bag and then stored in excellent storage or a refrigerated cupboard (temperature can be adjusted) at 10^0C. The method of storage is as follows: onion bulb seeds with v3 treatment (3 weeks) are put in first, one week later with v2 treatment (2 weeks), and two weeks later with v_1 treatment (1 week) are put in cool storage. After 3 weeks, all the onion bulbs treated v3, v2, and v_1 from excellent storage were taken out to be planted together in the field with shallot bulbs treated v_0 (not vernalized).

For tubers that have been vernalized according to treatment, ¼ part of the tip of the tuber is cut to stimulate the formation of shoots. Furthermore, to avoid attack by pathogenic fungi, soak tubers in Dithane M-45 fungicide solution with a concentration of 1% for 5 minutes. The regression model is as follows:

$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_{12} + b_4X_{22}$ (Sudjana, 1988)

Description:
$\hat{Y}$ = response variable (dry tuber weight per plot)
b_0 = Constant
b_1 = Regression coefficient of the linear effect of the duration of vernalization (X_1)
b_2 = Regression coefficient of the linear effect of chicken manure dose (X2)
b_3 = Regression coefficient of the quadratic effect of vernalization (X_1)
b_4 = Regression coefficient of the quadratic effect of chicken manure (X_2)
X_1 = Linear effect of the duration of vernalization
X_2 = Linear effect of chicken manure dose

Based on the results of Soil Analysis at the Soil, Plant, Fertilizer Laboratory of the Lembang Vegetable Crops Research Institute, West Java (2019), soil fertility at the study site was moderate, this was shown from slightly acidic pH (H_2O) and pH (KCl), moderate C-Organic, Medium total N, moderate C/N, high P_2O_5, low K_2O, high available P_2O_5, medium CEC, high Ca-dd, medium Mg-dd, low K-dd, and low Na-dd. Meanwhile, the levels of nutrients in chicken manure are C-organic 39.43, total N 2.18, C/N 15 alkaline pH, and 12% moisture content.

RESULTS AND DISCUSSION

Plant Height

Based on the variance results, there was an interaction between the Time of Vernalization and the dose of chicken manure on the character of plant height, as shown in Table 1.

Table 1 shows that the treatment without vernalization with a dose of chicken manure 20 tons ha^{-1} without vernalization (v_0k_2) was the best treatment for the high growth of shallot plants. Observation of plant height in this

study was only carried out until the age of 7 WAP. In contrast to the results of the research by Siswadi et al. (2019), eight weeks of vernalization time can increase the growth of garlic plants.

Table 1. Average Plant Height Interaction Time of Vernalization Treatment and Dose of Chicken Manure at the age of 7 WAP

Treatment : Time of Vernalization (V) :	Dose of Chicken Manure (K) : k_0 (0 ton ha^{-1})	k_1 (10 ton ha^{-1})	k_2 (20 ton ha^{-1})	k_3 (30 ton ha^{-1})
v_0 (controll)	20,88 a A	23,06 b B	23,53 c B	20,84 b A
v_1 (1 week)	19,20 a B	17,79 a A	22,31 b B	21,95bc B
v_2 (2 weeks)	19,87 a B	22,43 b C	19,47 a B	17,28 a A
v_3 (3 weeks)	20,11 a B	18,86 a A	22,59 b C	23,23 c C

Note: Based on Duncan's multiple range test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Number of Leaves

There was an interaction between the length of vernalization and the dose of chicken manure on the character of the number of leaves, as shown in Table 2.

Table 2. Average Number of Leaves Interaction Time of Vernalization Treatment and Dose of Chicken Manure at 7 WAP

Treatment : Time of Vernalization (V) :	Dose of Chicken Manure (K) : k_0 (0 ton ha^{-1})	k_1 (10 ton ha^{-1})	k_2 (20 ton ha^{-1})	k_3 (30 ton ha^{-1})
v_0 (controll)	21,00a A	19,00a A	20,17a A	21,00a A
v_1 (1 week)	19,83a A	20,42a A	19,92a A	20,25a A
v_2 (2 weeks)	20,42a A	19,58a A	18,58a A	20,50a A
v_3 (3 weeks)	20,58a AB	18,33a A	23,58b B	22,17a B

Note: Based on Duncan's multiple range test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Table 2 shows that the 3-week vernalization treatment with chicken manure dose of 20 t ha^{-1} (v_3k_2) was the best treatment for the growth of the number of leaves. The number of leaves will increase the results of photosynthesis, which will be converted into carbohydrates stored in the bulbs.

Flowering Age

Based on the variance results, there was an interaction between the length of vernalization and the dose of chicken manure on the flowering age characters as shown in Table 3.

Table 3. Average Age of Flowering Interaction Time of Vernalization Treatment and Dose of Chicken Manure

Treatment: Time of Vernalization (V) :	Dose of Chicken Manure (K) :			
	k_0 (0 ton ha^{-1})	k_1 (10 ton ha^{-1})	k_2 (20 ton ha^{-1})	k_3 (30 ton ha^{-1})
v_0 (control)	42,00c A	37,92b A	39,08b A	40,25b A
v_1 (1 week)	44,92c B	32,08a A	38,50ab AB	44,53b B
v_2 (2 weeks)	35,00b B	29,75a A	31,50ab AB	35,00a B
v_3 (3 weeks)	29,58a A	29,17a AB	29,75a AB	31,50a B

Note: Based on Duncan's multiple range test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Table 3 shows that the 3-week vernalization treatment with a dose of chicken manure 10 t ha^{-1} (v_3k_1) was the shortest treatment for shallot flowering age. Based on the description of Ministry of Agriculture No. 594/Kpts/TP.240/8/1984, Bima variety shallots are relatively tricky to flower naturally. However, from the results of the study, it was seen that three weeks of vernalization with a dose of 10 t ha-1 chicken manure could flower earlier at 29.17 days. The time of vernalization, the right temperature, and the correct fertilization dose can accelerate generative growth. This aligns with the research results of Fahrianty et al. (2020), who found that vernalization treatment for 30 days can increase flowering for planting in the highlands. The Bima Brebes variety in the highlands can flower 80% and 9.17% in the lowlands. Flowering on shallots is influenced by genetics (variety and hormonal) and the environment, such as temperature and duration of irradiation.

According to Prahardini and Sudaryono (2018), to produce a high percentage of shallot flowers in the tropics, it is necessary to induce flowering with a vernalization period of 4 weeks and a planting location altitude of >1000 above sea level. Changes in growth and development patterns from the vegetative to the generative phase are characterized by flower induction. Visually, morphological changes have not occurred, but the buds have physiological and biochemical changes. According to Rosalina et al. (2021), a six-week vernalized seedling produced the highest number of florets per umbel, seed weight per umbel, and plant.

Vernalization accelerated the start of flowering in all shallot varieties with different responses. Apart from being stimulated by vernalization, the flowering process is also stimulated by plant nutritional conditions, especially nitrogen, which must be available in optimum quantities. If the availability of Nitrogen is not optimum, even if the vernalization is carried out, it will not stimulate flowering too much. The fast flowering process will accelerate the formation and refinement of onion bulbs (Wibowo et al., 2017; et al., 2018; Fahrianty et al., 2020; Marlin et al., 2021).

Age of Harvest, Number of Wet Tubers per Clump, and Wet Weight of Tubers per Clump

Based on the results of variance, there was no interaction on the characters of harvesting age, number of wet tubers per clump, and wet weight of tubers per clump between the duration of vernalization and the dose of chicken manure. However, independently, there was a significant effect (Table 4).

Table 4. Average harvesting age, number of wet tubers per clump, wet weight of tubers per clump at a Time of Vernalization treatment, and doses of chicken manure

Treatment	Age of Harvest (days)	Number of Wet Tubers per Clump (fruit)	Fresh Tuber Weight per Clump (g)
Time of Vernalization (V) :			
v_0 (0 week)	61,83 a	6,02 b	42,87 a
v_1 (1 week)	71,67 b	5,67 ab	43,08 a
v_2 (2 weeks)	72,25 b	6,06 b	42,47 a
v_3 (3 weeks)	72,42 b	5,17 a	40,50 a
Dose of Chicken Manure (K) :			
k_0 (0 ton ha^{-1})	69,42 a	5,85 ab	41,47 a
k_1 (10 ton ha^{-1})	69,83 a	6,10 b	46,87 a
k_2 (20 ton ha^{-1})	69,83 a	5,79 ab	43,54 a

Note: Based on Duncan's multiple-distance test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Based on Table 4, the fastest harvesting age occurred at v0 (without vernalization treatment). The physiological maturity of the Bima variety of shallots ranged from 55-60 days. The delay in harvesting age was suspected because the vernalization treatment stimulated the activity of gibberellins, which carried out cell division, especially the generative part, thus inhibiting harvest age. Gibberellins (GA_3) stimulate increased cell differentiation, plant growth, and development. Long harvest age due to vernalization causes the tuber weight to shrink after drying because the older the onion is harvested, the lower the dry weight. The treatment dose of chicken manure on harvest age has no effect.

The most wet tubers per clump occurred in the 2-week vernalization treatment, although it was not significantly different from the 1-week treatment and control. Chicken manure treatment was not significantly different from other treatments on the number of wet tubers per clump. It is suspected that the chicken manure used with moderate C/N and moderate organic C levels (Results of Soil Analysis, 2019) can be categorized as mature. This condition allows increased air aeration, aeration of water in the soil, and field capacity, which can reduce soil acidity (pH). The decrease in soil acidity will increase nutrient uptake by plants. The mature manure material will increase the soil pH and reduce soil Al-allocated. The decrease in soil exchanged Al can increase nutrient uptake by plants on acid soils such as Andisols, Inseptisols, and Ultisols. The better dose of chicken manure is 10 t ha^{-1}.

This aligns with Sulasmi's research (2020) and Susilawati's (2022), namely that 10 t ha-1 of chicken manure provides the highest number of tubers, production per plant, and production per plot. Furthermore, Prasetyo and Sinaga (2017) stated that the organic dose treatment affected the wet tuber weight. In observing the weight of fresh tubers per clump, it can be seen that there is no effect of the time of vernalization and the dose of manure on all treatments. Factors causing the vernalization treatment had no effect, presumably because there was a missing effect due to high-temperature stress or devernalization. No effect of vernalization time and dose of chicken manure on wet tuber weight per clump indicated that too many shoot tubers caused the tubers to be minor, so the tuber weight per clump was not significantly different from one another. This is in line with the results of research by Rahmawati et al. (2018), which suggested that vernalization did not affect the growth of tuberose tubers.

Wet Tuber Weight per Plot

There was an interaction between the Time of Vernalization and the dose of chicken manure on the character of Wet Bulb Weight per Plot, as shown in Table 5.

Table 5. Average Weight of Wet Roots per Plot Interaction Time of Vernalization Treatment Dose of Chicken Manure

Treatment: Time of Vernalization (V) :	Dose of Chicken Manure (K) : k_0 (0 ton ha^{-1})	k_1 (10 ton ha^{-1})	k_2 (20 ton ha^{-1})	k_3 (30 ton ha^{-1})
v_0 (control)	815,67a AB	994,67b B	618,33a A	803,67ab AB
v_1 (1 week)	586,33a A	820,67ab AB	469,00a A	1204,00c B
v_2 (2 weeks)	599,00a A	974,67b A	803,33a A	934,67b A
v_3 (3 weeks)	801,00a B	727,67a AB	845,67a B	629,00a A

Note: Based on Duncan's multiple-distance test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Table 5 shows that the 1-week vernalization treatment with chicken manure dose of 30 tons ha^{-1} (v1k3) was the best treatment for shallot fresh bulb weight per plot. The right time of vernalization can increase biochemical reactions that encourage the complete process of photosynthesis to produce carbohydrates. Cell enlargement, more dominant than cell division in layered tubers, increased tuber wet weight. Photosynthesis results from the leaves, and the amount of water absorption affects the formation of tubers, affecting the wet weight of the tubers produced.

Vernalization of shallot bulb seeds can speed up the flowering process. Flowering indicates the transition from the vegetative phase to the generative phase, where the tuber formation begins. A delay in flowering will hinder the process of forming shallot bulbs, which will further reduce shallot bulb production.

Dry Tuber Weight per Plot

Based on the variance results, there was an interaction between the Time of Vernalization and the dose of chicken manure on the dry tuber weight per plot, as shown in Table 6.

Table 6. Average Weight of Dry Roots per Plot Interaction Time of Vernalization Treatment and Dose of Chicken Manure

Treatment: Time of Vernalization (V) :	Dose of Chicken Manure (K) : k_0 (0 ton ha^{-1})	k_1 (10 ton ha^{-1})	k_2 (20 ton ha^{-1})	k_3 (30 ton ha^{-1})
v_0 (control)	601,67b B	763,33b C	458,33a A	630,67ab B
v_1 (1 week)	725,67b B	619,33a B	316,33a A	964,00c C
v_2 (2 weeks)	373,33a A	779,67b B	979,33c B	755,33bc B
v_3 (3 weeks)	631,33b AB	600,67a AB	711,67b B	501,67a A

Note: Based on Duncan's multiple-distance test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Table 6 shows that the 2-week vernalization treatment with a dose of 20 tons ha^{-1} (v_2k_2) of manure was the best treatment for dry bulb weight of shallots per plot.

Harvest Index

Based on the variance results, there was an interaction between the duration of vernalization and the dose of chicken manure on the Harvest Index characters as shown in Table 7.

Table 7. Average Harvest Index Result of Interaction of Time of Vernalization Treatment and Chicken Manure Dose

Treatment: Time of Vernalization (V) :	Dose of Chicken Manure (K) : k_0 (0 ton ha^{-1})	k_1 (10 ton ha^{-1})	k_2 (20 ton ha^{-1})	k_3 (30 ton ha^{-1})
v_0 (controll)	0,74 ab A	0,78 a A	0,74 a A	0,78 a A
v_1 (1 week)	0,84 b B	0,76 a AB	0,67 a A	0,80 a AB
v_2 (2 weeks)	0,63 a A	0,81 a B	0,81 a B	0,81 a B
v_3 (3 weeks)	0,79 b A	0,83 a A	0,84 a A	0,79 a A

Note: Based on Duncan's multiple-distance test, the numbers followed by capital letters (rows) and lowercase letters (columns) are not significantly different at the 5% significance level.

Table 7 shows that the 1-week vernalization treatment without chicken manure (v_1k_0) is the best treatment for the shallot harvest index. The impact of vernalization on shallots is in the generative phase. In the generative phase, vernalization stimulates flowering but not tuber formation, and in the vegetative phase, vernalization only affects leaf formation.

Optimum Time of Vernalization and Dose of Chicken Manure follow the following equation:

$Y = 650.7708 - 0.0349X_1X_2 + 0.8069\ X_1\ X_2$

Description:

Y = dry tuber yield per plot

X_1 = vernalization

X_2 = chicken manure

The optimum time of vernalization is 4.22 weeks, and the optimum dose of chicken manure is 5.03 tons $ha^{-1,}$ resulting in a maximum dry weight of shallot bulbs of 4.97 tons ha^{-1}

CONCLUSION

1. There was an interaction between vernalization and plant height of chicken manure doses, number of leaves at 7 WAP, flowering time, weight of fresh and dry tubers per plot, and harvest index.
2. The optimal vernalization time is 4.22 weeks, the optimal dose of chicken manure is 5.03 t ha^{-1}, and the maximum dry weight of shallot bulbs is 4.97 t ha^{-1}.

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