International Journal of Research in Agricultural Sciences
Volume 5, Issue 5, ISSN (Online): 2348 – 3997

Research on Growth, Development and Yield of Ly Son Garlic (*Allium Sativum L.*) Plant Test Outside of Ecological Distribution

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Date of publication (dd/mm/yyyy): 05/11/2018

Abstract **– Ly Son garlic (*Allium sativum* L.) is high economic value. However, *A. sativum* is primarily planting in Ly Son island of Quang Ngai province, Vietnam. The first time, we were planted test *A. sativum* in the sandy field of Thua Thien Hue province, Vietnam. The results showed that *A. sativum* was suitable for growing and developing under natural conditions of Thua Thien Hue. In which, *A. sativum* was adapted higher in Vinh Thanh commune than in Quang Thai commune, Thua Thien Hue province, Vietnam. Result of investigating, we shown that the time from planting to maturity of *A. sativum* was from 120 to 145 days. Whereas, the number of leaves per plant was 8.2 and 9.8 leaves in Quang Thai and Vinh Thanh commune, respectively. Further, pseudostem height of *A. sativum* in Quang Thai (11.3 cm) and in Vinh Thanh (12.2 cm). Furthermore, the highest yield of *A. sativum* was recorded in Vinh Thanh with 8.04 t/ha and in Quang Thai was 6.03 t/ha. This result also showed that morphological characteristics, yield parameters such as bulb diameter, length of bulb, number of cloves per bulb of *A. sativum* planted in outside ecological distribution didn't differ comparing in ecological distribution. In our datas will providing science data and experimental facilities for planting new species for localities and improving the livelihoods of communities in difficult economic areas of Thua Thien Hue province.**

Keywords **– Allium Sativum, Development, Growth and Ly Son Garlic.**

I. INTRODUCTION

Garlic (*Allium sativum* L.) is a bulb and it belonging to the family Alliaceous. It is the second most widely cultivated crop after onion [1]. *A. sativum* crop originated from Central Asia and it spread to the other parts of the world through trade and colonization [2]. *A. sativum* is a high economic value tuber, one of three agricultural products (along with chilli and pepper) that play a major role in Vietnam's export spices [3]. Historically, garlic has been used around the world to treat many conditions, including hypertension, infections, and snakebites, and some cultures have used it to ward off evil spirits. Currently, *A. sativum* is used for reducing cholesterol levels and cardiovascular risk, as well as for its antineoplastic [4] [5] [6] [7] [8] and antimicrobial properties [9] [10].

In Vietnam, *A. sativum* was mainly planted in Ly Son island of Quang Ngai province, Vietnam [11]. Thus, planting test of *A. sativum* outside of ecological to assess of ability for growth and development of *A. sativum*.

Thua Thien Hue province of Vietnam have coastal sandy field land. In here, sandy field soil is quite wide, and the weather conditions are the same with Ly Son island. However, *A. sativum* no plant in here to now. Therefore, we conducted experiments on *A. sativum* on the sandy field soil of Quang Thai commune, Quang Dien district and Vinh Thanh commune, Phu Vang district, Thua Thien Hue province to study on the growth, development and yield. This result will provide science data to collection a suitable crop and economic development for farmers here.

II. MATERIALS AND METHODS

Experimental Material

Ly Son garlic (*Allium sativum* L.) purchased in An Hai commune, Ly Son district, Quang Ngai province. Select the cloves garlic have highly homologous, no layer grade and hard.

Methods

* *Experimental Layout*

The experiment was conducted by using randomized complete block design (RCBD), with three replications at the sandy field soil of Quang Thai commune, Quang Dien district and Vinh Thanh commune, Phu Vang district, Thua Thien Hue province, Vietnam.

Quang Thai and Vinh Thanh commune, Thua Thien Hue province have ecological and climatic conditions similar to Ly Son district, Quang Ngai province. The sand field soil and climatic conditions in these areas are quite suitable for planting *A. sativum*.

* *Land Preparation and Planting:* [12]

Make the soil: Scratch the sand layer into piles, a new layer of basalt soil about 1 - 2 cm, compacted. Then fertilize (compost + NPK fertilizer), spread about 1 cm of old sand on basalt soil and continue to spread a layer of sand to 1.5 – 2.5 cm thick on the top.

Planting density: row to row distance: 14 cm x 15 cm; plant to plant distance: 6 cm x 7 cm.

How to grow: Begin planting by carefully breaking apart the bulb to separate the individual cloves and keep the papery husk on each individual clove. Place cloves in their upright position (the wide root side facing down and pointed end facing up). Cover them back over with soil so that the tips of the cloves are only just below the surface.

A. sativum was planted in November 2017.

* *Data Collection*

Data were collected on following parameters:

The data on growth, development, productivity was determined by measuring and counting routines in plant physiology research.

The bio-agronomic characteristics of garlic were determined by PPV and FRA [3].

III. Results and Discussion

Growth Parameters of A. Sativum

Time of Growth and Development of A. Sativum

A. sativum germinated completely after 7 days planting and seedlings began to form real leaves from 10 to 25 days after planting (Table 1, Figure 1). *A. sativum* well grow and development well, leaves are arranged in a concentric shape after it had 2 to 3 leaves (Table 1, Figure 1). When *A. sativum* is formed from 12 to 15 leaves, no leaf formation occurs. In each axillary leaf, there is a small bud that later expanded to garlic cloves (Table 1, Figure 1). *A. sativum* cloves are in the shell covered by the outer layers (made by the leaf blossoms), which later formed a garlic. The time from planting to clumping garlic cloves is 87 days (Table 1, Figure 1). *A. sativum* was harvested in 120 - 130 days after planting in Quang Thai commune, while in Vinh Thanh has a harvesting time was 125 - 140 days. Similar, Hoang (2011) planted in An Hai commune, Ly Son district showed the from planting to harvesting times were from 125 to 140 days [13].

Leaf Number per a. Sativum plant

Lower-case letters in a cell show results of significant differences between treatments using Duncan's multiple range test ($p < 0.05$). The same letters within each column and each row indicates no statistically significant differences. The values represent the mean (± SE) of three independent experiments. The highest statistically significant mean value was bold.

Number of leaves of *A. sativum* per plant differed significantly among different times after planting. *A. sativum* had significantly highest number of leaves after 120 days planted in Vinh Thanh (Table 2). This result is similar with research of Hoang (2011), in here *A. sativum* was planted in Ly Son island, Quang Ngai province has a total leaf per plant average of from 9 to 10 leaves [13]. In our data suggested *A. sativum* planting in Vinh Thanh was suitable for the leaf growth.

Pseudostem Height of A. sativum

Our data showed that pseudostem height of *A. sativum* also plant differed significantly among different times after planting (Table 3). The highest pseudostem height of *A. sativum* at Vinh Thanh was 12.2 cm after 120 days planting (Table 3). Similar, Vo (2013) reported that pseudostem height of *A. sativum* in Ly Son was over 10 cm [12].

Yield Parameters of A. sativum

Morphological Parameters of A. sativum after Harvested

A. sativum planted in Vinh Thanh and Quang Thai commune about characteristics of bulb as shape in cross section, compactness of cloves, shape of base, distribution of cloves, shape in longitudinal section, position of cloves at tip of bulb and characteristics of clove per bulb as colour of scale, colour of flesh were same (Table 4, Figure 2). In characteristics of ground colour of dry external scales, most of them are white, a little of them are purple (Quang Thai) or yellowish white (Vinh Thanh). In particular, these purple of ground colour of dry external scales are found only in lonely *A. sativum*. This may be due to the original breed. These findings are in agreement with the reports of Vo (2011) and Ho (2013) [12][14]. They reported that most of morphological characteristics of garlic are influenced by genetic factors, less influenced by external conditions, except for some parameters are affected by the environment such as bulb shape in cross section, colour of flesh.

All yield morphological parameters of *A. sativum* after harvested in Vinh Thanh significantly higher than in Quang Thai, except length of bulb (Table 5). Our data was similarly with the reports of of Hoang (2011), Ho (2013). Here, they reported that *A. sativum* planted in Ly Son island, Quang Ngai province has bulb diameter, length of bulb, number of cloves per bulb with 2.7 cm, 2.45 cm, 18.0, respectively [12] [13]. Special, yield of *A. sativum* was planted in Vinh Thanh with 8.04 t/ha. Whereas, Ho (2013) reported that the average yield of in Ly Son district, Quang Ngai province was only 3.0 – 4.0 t/ha. So, this study shows that the sandy field soil in Vinh Thanh commune, Phu Vang district, Thua Thien Hue province is very suitable for growing, development of *A. sativum*.

IV. Conclusions

In our research, we investigated *A. sativum* planting test outside ecological distribution to ability growth and development. We showed that the time of growth and development, number of leaves, pseudostem height and yield parameters in Vinh Thanh commune were significantly higher in Quang Thai commune, Thua Thien Hue province. In additions, our results are similarly in ecological distribution in Ly Son island, Quang Ngai province, whereas, yield of *A. sativum* in Vinh Thanh is higher in Ly Son. This result suggested that *A. sativum* may be planted in Quang Thai and Vinh Thanh, Thua Thien Hue province.

Acknowledgments

I acknowledge the financial assistance from Hue University of Education (Project No. T.18-TN-08).

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Table 1. Time of growth and development of A. sativum in Thua Thien Hue province

Growth and development	Location of planting /Time (days)	
	Quang Thai, Quang Dien	Vinh Thanh, Phu Vang
Full germination	7	7
Begins to form garlic cloves	87	87
Days to emergence	120	125
Days to maturity	130	140

Table 2. Number of leaves/plant and the rate of leaf formation of A. sativum during the study period.

Location of planting	Number of leaves per plant at different time (days) after planting							
	15	25	35	45	55	65	75	120
Quang Thai	$2.6^{a} \pm 0.5$	$3.6^{bc} \pm 0.5$	$3.8^{bc} \pm 0.4$	$3.8^{bc} \pm 0.4$	$4.2^{cd} \pm 0.5$	$4.6^{de} \pm 0.5$	$5.2^{ef} \pm 0.4$	$8.2^{f} \pm 0.7$
Vinh Thanh	$3.4^{b} \pm 0.5$	$3.8^{bc} \pm 0.4$	$4.2^{bc} \pm 0.4$	$4.4^{cd} \pm 0.5$	$4.8^{de} \pm 0.6$	$5.6^{f} \pm 0.7$	$6.4^{g} \pm 0.6$	$\mathbf{9.8^{i}} \pm 1.1$

Lower-case letters in a cell show results of significant differences between treatments using Duncan's multiple range test ($p < 0.05$). The same letters within each column and each row indicates no statistically significant differences. The values represent the mean (± SE) of three independent experiments. The highest statistically significant mean value was bold.

Table 3. Pseudostem height of A. sativum (cm) during the study period

Location of planting	Pseudostem height of *A. sativum* (cm) at different time (days) after planting			
	45	60	75	120
Quang Thai, Quang Dien	$4.1^{a} \pm 0.08$	$5.9^{c} \pm 0.09$	$8.2^{e} \pm 0.12$	$11.3^{g} \pm 0.21$
Vinh Thanh, Phu Vang	$5.5^{b} \pm 0.29$	$6.3^{d} \pm 0.15$	$8.7^{f} \pm 0.21$	$\mathbf{12.2^{h}} \pm 0.45$

Lower-case letters in a cell show results of significant differences between treatments using Duncan's multiple range test ($p < 0.05$). The same letters within each column and each row indicates no statistically significant differences. The values represent the mean (± SE) of three independent experiments. The highest statistically significant mean value was bold.

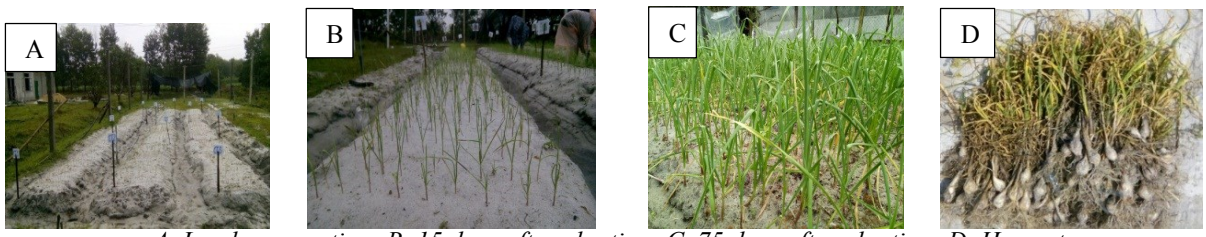
Table 4. Morphological parameters of A. sativum after harvested.

Characteristics of bulb	Location of planting	
	Quang Thai	Vinh Thanh
Ground colour of dry external scales	97,6% white; 2,4% purple	90% white; 10% yellowish white
Shape in cross section	100% circular	100% circular
Compactness of cloves	100% compact	100% compact
Shape of base	100% recessed	100% recessed
Distribution of cloves	100% radial	100% radial
Shape in longitudinal section	100% elliptic	100% elliptic
Position of cloves at tip of bulb	100% exerted	100% exerted
Colour of scale clove	100% cream	100% cream
Colour of flesh clove	100% white	100% white

Table 5. Yield parameters of A. sativum

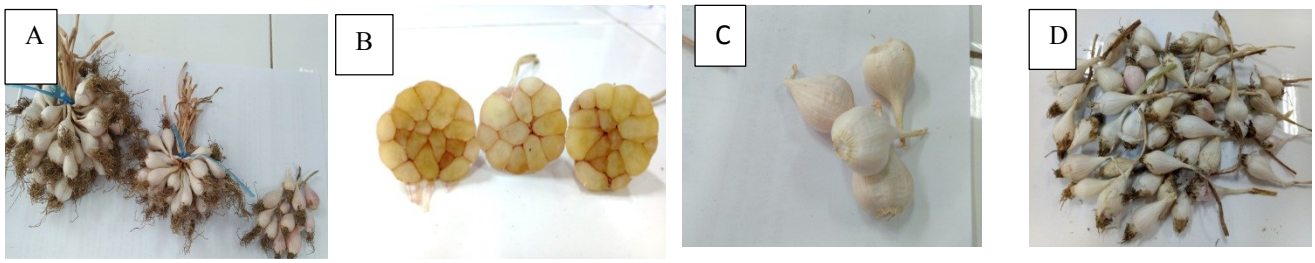
Yield of garlic	Location of planting		Level of significance
	Quang Thai	Vinh Thanh,	
Bulb diameter (cm)	1.69 ± 0.05	2.93 ± 0.04	*
Length of bulb (cm)	2.80 ± 0.12	2.45 ± 0.08	*
Number of cloves per bulb	8.40 ± 0.82	12.5 ± 0.49	*
Weight of bulb (g)	5.74 ± 0.15	9.3 ± 0.26	*
Yield of bulb (ton/ha)	6.03 ± 0.07	8.04 ± 0.12	*

The values represent the mean (± SE) of three independent experiments. * Significant differences between treatments ($p < 0.05$).



A. Land preparation; B. 15 days after planting; C. 75 days after planting; D. Harvest

Fig. 1. Some photos of growth stages of A. sativum were planting on sandy field soil of Thua Thien Hue province.



A. Harvesting of A. sativum; B. Bulb: Shape in cross section, Clove: Colour of flesh, Bulb: Distribution of cloves; C. Bulb: Ground colour of dry external scales (white); D. Lonely garlic.

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