PROCEEDING

International Seminar on Tropical Horticulture

2016

"The Future of Tropical Horticulture"

Organized by

ISBN 978-979-18361-5-9

Proceeding International Seminar on Tropical Horticulture 2016 : *The Future of Tropical Horticulture*

ISBN : 978-979-18361-5-9

Editor :
Dr. Awang Maharijaya, SP, M.Si
Dr. Ir. Darda Efendi, M.Si

Layout and Cover Design :
Ferdhi Isnan Nuryana, SP

Publisher :
Pusat Kajian Hortikultura Tropika (PKHT) - LPPM IPB

Editorial :
Pusat Kajian Hortikultura Tropika (PKHT)
Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM)
Institut Pertanian Bogor (IPB)
Kampus IPB Baranangsiang, Jl Raya Pajajaran, Bogor 16144
Telp. (0251) 8326881; Fax. (0251) 8326881

First Edition, May 2017

FOREWORD

The International Seminar on Tropical Horticulture 2016 was held in IPB International Convention Center, Bogor, Indonesia 28 – 29 November 2016. This seminar was organized by Center of Excellence for Tropical Horticulture Studies (PKHT), Center of Excellence in University (PUI-PT), Bogor Agricultural University (IPB), and supported by an excellent collaboration with International Tropical Fruits Network (TF Net).

We're very glad to know the fact that the seminar displayed a very wide discussion about tropical horticulture with delegates from 5 countries (Taiwan, Thailand, Malaysia, Japan and Indonesia) as keynote speech and participants. 24 papers were selected to be included in this proceeding from 28 oral and 31 poster presentation.

This proceeding is contained of three sub chapter, that is fruits, vegetables and miscellaneous. There are 9 papers of fruits chapter, 12 papers of vegetables chapter and 3 papers of miscellaneous chapter. We wish to thank Sanjeet Kumar, Ph.D, Prof. Sobir, Prof Masayoshi Shigyo, Dr. Mohd Desa Haji Hassim, Parson Saradhuldhat, Ph.D for being keynote speech at this international seminar and all participants for very lively atmosphere during and after the seminar.

Bogor, May 2017

Editor

Dr. Darda Efendi
Dr. Awang Maharijaya

SYMPOSIUM PROGRAM

28 November 2016

07.30 – 09.00	*Registration desk open and morning coffee*
09.00 – 09.30	Welcome addresses **Dr. Darda Efendi**, Director of Center for Tropical Horticulture Studies, Indonesia **Prof. Herry Suhardiyanto,** Rector of Bogor Agricultural University, Indonesia
09.30 – 12.00 (20 minutes presentation + 10 minutes discussion)	**Session 1: Introductory Topics** **Dr. Sanjeet Kumar,** World Vegetable Center, Taiwan *"Science and Art of Tropical Horticulture: Stories, Impacts and Prospects"* **Prof. Sobir,** Indonesian Center of Excellence for Tropical Horticulture *"Tropical Horticulture: Past, Present and Future"* **Gregori Hambali, MSc,** Mekarsari, Indonesia *"Managing Tropical Fruit Collection"*
12.00 – 13.00	*Lunch*
13.00 – 14.30 (20 minutes presentation + 10 minutes discussion)	**Session 2: Opportunity in Tropical Horticulture Industry** **Prof. Muhammad Firdaus,** Bogor Agricultural University *"Enhancing the Competitiveness of Tropical Horticulture Products"* **Dr. Mohd Desa Haji Hassim,** International Tropical Fruit Network, Selangor, Malaysia *"Issues and Challenges in The Global Tropical Fruit Market"* **Parson Saradhuldat, Ph.D,** Department of Horticulture, Kasestsart University, Thailand *"Tropical Horticulture Business in Thailand"*
14.30 – 16.00 (20 minutes presentation + 10 minutes discussion)	**Session 3: Quality of Horticultural Products** **Dr. Darda Efendi,** Center for Tropical Horticulture Studies, Indonesia *"Quality Issues in Tropical Horticultural Products"*

	Tatas H. P. Brotosudarmo, PhD, Ma Chung University *"Non-optical and optical spectroscopy as metabolomics platforms for determining the quality of horticultural products"* **Dr. Irmanida Batubara,** Tropical Biopharmaca Research Center *" Quality Control on Herbal Medicine"*

29 November 2016

07.30 – 08.30	*Registration desk open*	
08.30 – 10.15	**Parallel session 1**	**Parallel session 2**
10.15 – 10.30	*Coffee Break and Poster Session*	
10.30 – 12.15	**Parallel session 3**	**Parallel session 4**
12.15 – 13.00	*Lunch*	
13.00 – 15.00 (@20 minutes presentation + 10 minutes discussion)	**Session 4 : Technology Needs for Improving Horticulture in The Tropics** **Prof. Masayoshi Shigyo,** Yamaguchi University, Japan *"Proposal for a forwarding model in order to encourage social interaction among HRs and/or PGRs via platform operation based on research collaboration in Indonesian vegetable crops"* **Prof. Sri Hendrastuti Hidayat,** Department of Plant Protection. Faculty of Agriculture. Bogor Agricultural University *"Integrated Disease Management for Vegetable Crops: Concepts and Practices"* **Dr. Catur Hermanto,** Indonesian Vegetables Research Institute (IVEGRI) *"Pest And Disease Threats and Challenges For Future Vegetable In The Tropic"*	
15.00 – 16.00	*Concluding and Remarks*	
16.00 – 18.00	*Farewell Drink*	

ORAL PRESENTATION SCHEDULE

Tuesday, November 29th 2016

Paralel 1

TIME	PRESENTER NAME	CODE	TITLE
08.30 – 08.45	Slamet Susanto	OP 1	Prolong Shelflife of Seedless Pummelo (*Citrus maxima* (L.) Osbeck) Fruit During Storage
08.45 – 09.00	Dini Hervani	OP 2	Cryopreservation of Long-term Plant Germplasm Storage
09.00 – 09.15	Sulassih	OP 3	Variability of Jackfruit Based on Morphology and Molecular ISSR
09.15 – 09.30	Ahmad Solikin	OP 4	Characterization of Local Durian Varieties In Central Java Using Molecular Markers Inter Simple Sequence Repeats (ISSR)
09.30 – 09.45	Nelinda	OP 5	Packaging Design and Postharvest Treatment to Maintain the Quality of Rambutan (*Nephelium Lappaceum* L.) in Distribution System
09.45 – 10.00	Maxmilyand Leiwakabessy	OP 6	Disease Incidence and Molecular Analysis of Banana Bunchy Top Virus in Bogor, West Java
10.00 – 10.15	Ajmir Akmal	OP 7	Transpiration rate of relationship fruit with Gamboge of Mangosteen (*Garcinia mangostana* L.)

Paralel 2

TIME	PRESENTER NAME	CODE	TITLE
08.30 – 08.45	Juang Gema Kartika	OP 8	Growth and Production of Some *Moringa oleifera* Lam. Accession at Several Harvesting Interval
08.45 – 09.00	Lutfi Izhar	OP 9	Conservation Agriculture with Soil Health: Optimal Fosfor Fertilizer Rate for Tomato (*Lycopersicon esculentum* Mill. L) on Inceptisols
09.00 – 09.15	Adhitya Mahendra K	OP 10	Stakeholders Analysis in Seed Provision System Development Originated from True Seed of Shallot
09.15 – 09.30	Endro Gunawan	OP 11	Policy Analysis on Shallot Stock Seed Program Though The Botanical Seed (*True Shallot Seed*) TSS
09.30 – 09.45	Ali Asgar	OP 12	Integrating Understanding of Indigenous Vegetable Nutrients and Benefits
09.45 – 10.00	Marlin	OP 13	Metabolite Changes in Shallot (*Allium cepa* var *aggregatum*) during Vernalization
10.00 – 10.15	Suhesti Kusuma Dewi	OP 14	The Effects of Vernalization and Photoperiod on Flowering of Shallot (*Allium cepa* var. *ascalonicum* Baker) in Lowland Area

Paralel 3

TIME	PRESENTER NAME	CODE	TITLE
10.30 – 10.45	Satriyas Ilyas	OP 15	Study of Phenology and Determination of Seed Physiological Maturity of Long Bean (*Vigna sinensis* L.) Based on Heat Unit
10.45 – 11.00	Endah Retno Palupi	OP 16	Chromosome Number Estimation of Diploid, Autotetraploid and Triploid Hybrid 'Rejang' Banana Using Protoplast from Male Flower (anther)
11.00 – 11.15	Yudiwanti Wahyu	OP 17	Performance of Some First Generation Corn Populations derived from Selfing and Sibbing for Developing Baby Corn Varieties
11.15 – 11.30	Ady Daryanto	OP 18	Inheritance of Chili Pepper Resistance Against Infestation of *Aphis gossypii* Glover (Hemiptera: Aphididae)
11.30 – 11.45	Edi Santosa	OP 19	Variation in Floral Morphology of Agamosporous *Amorphophallus Muelleri* Blume of Natural and Gibberellins Treatment
11.45 – 12.00	Kusuma Darma	OP 20	The Eco-Friendly Technology to Control Pests and Diseases of Shallot
12.00 – 12.15	Filemon Yusuf	OP 21	Phylogenetic Study of Indigenous Pulses Based on Morphological and Inter Simple Sequence Repeat (ISSR) Markers

Paralel 4

TIME	PRESENTER NAME	CODE	TITLE
10.30 – 10.45	Ririh Sekar Mardisiwi	OP 22	Growth and Production of Black Cumin (*Nigela sativa* L.) at Several Composition Media and Watering Interval
10.45 – 11.00	Evi Setiawati	OP 23	Growth and Production of Black Cumin (*Nigela sativa* L.) at Shade Levels and Nitrogen Doses
11.00 – 11.15	Tatik Raisawati	OP 24	The Nutritional Value and Total Flavonoid Content of *Sonchus arvensis* L. Leave
11.15 – 11.30	Dewi Sukma	OP 25	Diversity Analysis of Phalaenopsis by Using SNAP Marker
11.30 – 11.45	Widya Sari	OP 26	Morphological, Molecular Charactheristics and Pathogenicity of *Fusarium* spp. from Some Cultivars of Banana
11.45 – 12.00	Juwartina Ida Royani	OP 27	In Vitro Shoots Multiplication of Sapodilla (*Manilkara zapotta* Van Royen) with Modified MS Media
12.00 – 12.15	Willy B. Suwarno	OP 28	Melon Breeding: Past Experience and Future Challenge

Table of Content

Fruits

Vegetables

Miscellaneous

The Effects of Vernalization and Photoperiod on Flowering of Shallot (*Allium cepa* var. *ascalonicum* Baker) in Lowland Area

Suhesti Kusumadewi[1], Hamim[1], Sobir[2,3]

[1)] *Departement of Biology, Bogor Agricultural University, Indonesia*
[2)] *Departemen of Agronomy and Horticulture, Bogor Agricultural University, Indonesia*
[3)] *Center for Tropical Horticulture Studies, Bogor Agricultural University, Indonesia*

Abstract

Flower development is a key element of seed production in plants. In Allium genera, this process strongly influenced by photoperiod and temperature. Photoperiod has been reported as important factor on shallot flowering in highland area, however the effect on lowland area has not been reported. This research was aimed to analyze the effects of vernalization and photoperiode on shallot flowering in lowland area. This experiment was carried out using local shallot varieties i.e: bulbs of Bima Brebes and Sumenep cultivars. The experiment was arranged in split plot design with 3 replication. The main plot was photoperiod with 3 treatments i.e: natural light (control), 2 hours night break, 4 hours extension using additional light while the subplot was vernalization of bulb seedlings with ambient (room temperature) and cold temperature (10°C) for one month. Vernalization increased the shallot flowering up to 11.68% in Bima Brebes cultivar and 2.85% in Sumenep cultivar. Photoperiod slightly decreased the percentage of flowering, but increased the bulbing ratio significantly. Both vernalization and photoperiod treatments decreased leaf biomass, leaf number and plant height. Vernalization effectively induced shallot flowering in lowland area, while photoperiod effectively induced shallot bulbs formation.

1. Introduction

Shallot (*Allium cepa* var. *ascalonicum* Baker) is a member of the genus Allium that closely related with onion (*Allium cepa* L.), which has a lot of bulbs in one cluster (ascalonicum) (Brewster, 1994). In Indonesia, shallot has been developed and cultivated by farmers, both in lowland and highland, because it is one of comodities that has high economic value as ingredient or food seasonings as well as for the food industry (Putrasameja dan Suwandi, 1996). However, this commodities price is often fluctuated in the national market because of unstability between supply and demand (Rachmat *et al.* 2012). This condition occured because the shallot production is only seasonal, which is generally planted in April or May, and July or August (Sumarni and Hidayat, 2005).

The attempt to increase shallot production has many constraints, especially due to seed shortage. Farmers usually still use bulbs as planting material considering the easier to use and has shorter harvest time than using true shallot seeds (TSS), though the allocation of production cost for supplying the bulbs seedlings was around 40% of total cost (Suherman dan Basuki, 1990). TSS is an alternative solution to solve this problem as it has several advantages, such as free of virus and seed borne diseases, not voluminous, reduce production cost of the planting material, healthier plants, and higher productivity than the bulb seedlings (Basuki, 2009).

TSS sometimes lacks the ability to flower naturally and producie seeds which results the average of flowering capability of shallot only 30% in highland area and even does not blooming in the lowland area (Putrasamedja and Permadi, 1994). True shallot seed production in Indonesia is still carried out in the highlands because it is an appropriate location to induce shallot flowering. The selection of planting sites will effect the productivity of seeds as the ambient temperature plays an important role in the success of shallot seeds production. In general, the highland is an optimum location to induce flowering of shallot (Rosliani *et al.* 2013), while the lowlands are less suitable for initiation of shallot flowering (Putrasamedja and Suwandi, 1996). Vernalization treatment given to bulbs before planting may be the solution to increase the initiation of flowering in lowland area. The flowering percentage of shallots from Indonesia can be increased by storing bulb seedlings at temperature 4-10°C for 4 weeks (Rabinowitch and Currah, 2002). In onion, optimum temperature required to anable flowering is between 8-12◦C (Brewster, 2008).

Light is also one of important factor that affects flowering in the genus Allium. In general, shallot plants require photoperiod longer than 10 hours to bloom (Khokhar *et al.* 2007; Sopha et al. 2014). However, the research on the effect of photoperiod on shallot in Indonesia is still rare. This because Indonesia is located in equatorial region where the length of day and night is relatively similar all the year (Sutoyo, 2011). Sopha *et al.* (2014) reported that exposure over 10 hours on shallots on the highland area was able to increase flowering. However, there is no report about the effects of photoperiod on shallot flowering in lowland condition.

Photoperiod not only affects flowering in the genus Allium, but also affects the bulbs formation. Unfortunately, the study about development of shallot bulbs are still not much as in onion (Okubo *et al.* 1999). One of the environmental factors that affect the formation of bulbs was additional long day photoperiod (Rabinowitch and Currah, 2002). The ability of flowering and bulb formation of a plant is also influenced by genetic factors, so the physiological response of photoperiod and vernalization is different between varieties (Krontal *et al.* 2000). Therefore, it is necessary to test the influence of vernalization and photoperiod for inducing flower and formation of shallot bulbs in different varieties. This research was aimed to determine the effects of vernalization and photoperiod on shallot flowering in lowland area.

2. Material and Methods

The experiment was conducted at the Field Laboratory of Bogor Agricultural University in Ciomas, Bogor (06' 36'' 484°S, 106' 47'' 065°E) at altitude of 270 m a.s.l. from January to April 2016. Materials used in this study were bulb seedlings of shallot cultivars Bima Brebes and Sumenep with average of weight was around 5-7 g. Other materials were manure, NPK fertilizer (16-16-16) and dolomite lime. The equipments used were LED (Light-emitting diode) lamps 11 W (equivalent to a 100 W incandescent bulb), timers, cold storage, vernier caliper and thermometer.

The experiment was arranged in split plot design with 3 replications. The main plot was photoperiod with 3 treatments, i.e. natural light, 2 hours night break and 4 hours extension and the subplot was vernalization of bulb seedlings using ambient (room) temperature and cold temperature (10°C) for one month.

The natural photoperiod treatments was given by direct sunlight on the growing season as control. Four hours-extension treatment was applied similar as a natural treatment but given by addition of light exposure after natural light was gone (4 hours after sunset). Night break-treatment was given by additional light exposure at 23.00-01.00 (for 2 hours). Photoperiod treatment was given at the beginning of the vegetative phase, from 1 WAP (Week After Planting) untill harvest. Each unit consist of three pots size 25 cm with the volume of 4 kg soil, and each pot was planting three sets shallot seedlings.

The observed parameters were percentage of flowering, bulbing ratio, leaf biomass, plant height and leaf number. The data was analyzed using Analysis of Variance test (ANOVA) and followed by Least Significant Difference (LSD) at 95% significance level using STAR (Statistical Tools for Agricultural Research) software ver. 2.0.1.

3. Results and Discussion

Vernalization affected significantly on the percentage of flowering plants but not photoperiod treatment. In all photoperiod treatments only the plants that were treated by vernalization able to flower, while plants without vernalization were not able to produce flower, both on Bima Brebes and Sumenep cultivar (Figure 1).

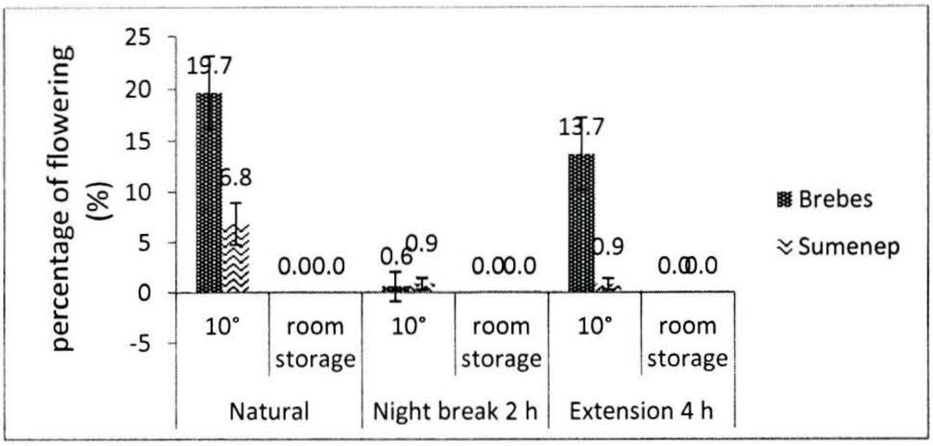

Figure 1. Effect of photoperiod and vernalization on percentage of shallot flowering

The data shows that the treatment using 4 hours extension and 2 hours night break had negative impact on flowering because those treatments even caused percentage of flowering lower than under natural conditions. In Bima Brebes cultivar, percentage of flowering in natural photoperiod was 19. 66%, whereas with 4 hours additional application it was 13. 68 % and in 2 hours night break it was only 1.71%. On the other hand, in Sumenep cultivar the percentage of flowering in natural photoperiod was 6.84%, whereas in extension it was 0.58% and night break it was 0.85%. The plants grown under natural or additional photoperiod without vernalization treatment were not able to flower (0%). The ambient temperature (without vernalization treatment) where the bulb seedlings was stored around 20-40°C has been known to be able to delay the inflorescence development (Krontal *et al.* 2000). This indicates that vernalization had stronger effect than photoperiod in inducing shallot flowering, and photoperiod did not able to replace the vernalization on shallot. In onion, vernalization was sufficient to induce flowering, while photoperiod and temperature advanced the inflorescence appearance, spathe opening and floret opening (Khokhar *et al.* 2007).

In this study, additional photoperiod significantly decreased the flowering ability. The reason behind this phenomen was not clear, since shallot is a long day plant (Sopha *et al.* 2014). The reason possibly related to the temperature of cultivation site. Thes cites of this research located in lowland area where the temperature average was around 25°C (Figure 2). This phenomenon had been reported via molecular study, that flowering was promoted by vernalization and correlates with upregulation of *AcFT2* gene, whereas bulb formation is promoted by *AcFT1* gene. Bulb formation is prevented by *AcFT4*. long-day photoperiods lead to the downregulation of AcFT4 and the upregulation of AcFT1, and this caused to promote bulbing.

Furthermore, the genetic factor also affected flowering ability. Flowering ability of Bima Brebes cultivar was significantly higher than Sumenep cultivar. Some reports suggested that Bima Brebes cultivar was one of shallots cultivar which was able to flower with low rate, while Sumenep cultivar was apparently very difficult to be flowering (Putrasameja and Suwandi, 1996).

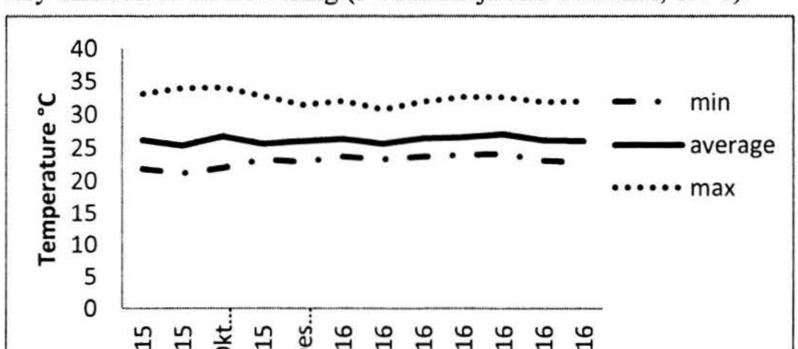

Figure 2. Environment temperature in 06' 36'' 484°S, 106' 47'' 065°E at altitude 270 m a.s.l.

Long photoperiod plus high temperature condition (25-30°C) caused degeneration of onion inflorescence within plant by competition of bulbing (Brewster, 2008). This fact was similar with the result of bulbing ratio in this experiment. The result showed that 2 hours night break increased bulbing ratio (Table 1). Bulbing ratio is ratio between maximum bulb diameter:minimum pseudostem. This ratio value could be used to observe the bulb formation with increasing in the ratio of bulbs (Okubo *et al.* 1999; Yamazaki *et al.* 2003; Brewster, 2008). Garner and Allard (1920), the first investigator, reported that long day photoperiods promoted bulbs development in onions. Further research showed that in long day condition, bulbing was faster in higher temperature (Brewster, 2008).

Table 1. The effect of photoperiod and vernalization on bulbing ratio

Treatments	6 WAP	7 WAP	8 WAP
Photoperiod:			
Natural	3.31 b	5.08 b	10.33 b
Night break 2 hours	4.37 a	7.84 a	13.46 a
Extension 4 hours	3.29 b	5.32 b	9.46 b
Vernalization:			
Without vernalization _Bima Brebes	3.26 b	5.39 b	10.54 a
Vernalization 10°C _Bima Brebes	3.97 a	7.00 a	12.05 a
Without vernalization _Sumenep	3.12 b	4.91 b	9.88 a
Vernalization 10°C _Sumenep	4.27 a	7.03 a	13.00 a

There is not interaction between main plot and subplot. Figures followed by the same letter in the same column are not significantly different at LSD with a level of 5%. (WAP: Week After Planting)

Photoperiod and vernalization also influenced plant height, leaf number per cluster and leaf dry mass significantly. In photoperiod treatment, 2 hours night break caused those parameters was lower than both natural photoperiod and 4 hours extension, while in vernalization treatment plant height and leaf number per cluster in ambient temperature (control) was higher than that of vernalization in 10°C, both in Bima Brebes and Sumenep cultivar (Table 2). In 2 hours night break bulb formation probably caused degeneration of vegetative growth. Lancaster (1996) reported that bulbing terminated leaf production in onion. During the juvenile phase onions could not be induced to flower or bulbing until reach a certain critical weight or leaf number (Brewster, 2008). In addition to photoperiod, vernalization also decrease those vegetative parameters. In garlic, vernalization at temperature 5-10°C was able to increase the percentage of flowering but inhibited the growth of vegetative, such as plant height, pseudostem diameter, number of leaves as well as to increase the production of peroxidase and superoxide dismutase (Wu *et al.* 2016)

Table 2. The effect of photoperiod and vernalization on vegetative traits

Treatments	Plant Height (cm)	Leaf/cluster	Leaf dry mass (g)
Photoperiod:			
Natural	45.80 a	26.48 a	1.74 a
Night break 2 hours	42.44 b	17.68 b	1.07 b
Extension 4 hours	44.34 ab	24.08 a	1.52 a
Vernalization:			
Without vernalization _Bima Brebes	48.24 a	26.17 a	1.91 a
Vernalization 10°C_Bima Brebes	46.49 b	18.79 b	1.54 b
Without vernalization _Sumenep	42.01 c	27.05 a	1.27 bc
Vernalization 10°C _Sumenep	40.03 d	18.98 b	1.05 c

There is not interaction between main plot and subplot. Figures followed by the same letter in the same column are not significantly different at LSD with a level of 5%.

4. Conclusion

The results suggest that cultivation of shallot in lowland area needs vernalization treatment to induce flowering. Photoperiod did not able to replace the vernalization on shallot flowering in lowland area. Additional photoperiod even thightly decreased the shallot flowering ability, but increased the bulb development. Flowering ability of Bima Brebes cultivar was higher than Sumenep cultivar.

Acknowledgements

SK is supported by Shallot Project (Center for Tropical Horticulture Studies), Ministry of Research, Technology and Higher Education of the Republic of Indonesia for awarding the Fresh Graduate Scholarship 2014-2016, and the Plant Physiology Laboratory of Biology Department, Bogor Agricultural University.

References

Basuki RS. 2009. Analisis kelayakan teknis dan ekonomis teknologi budidaya bawang merah dengan biji botani dan benih umbi tradisional. *J. Hort.* 19(2):214-227.

Brewster JL. 1994. *Onions and other vegetable alliums.1st ed.* London (GB): CABI Publishing.

Brewster JL. 2008. *Onions and other vegetable alliums. 2nd ed.* London (GB): CABI Publishing.

Fahrianti D. 2013. Peran vernalisasi dan zat pengatur tumbuh dalam peningkatan pembungan dan produksi biji bawang merah dataran rendah dan dataran tinggi [Thesis]. Bogor (ID): Institut Pertanian Bogor.

Garner WW, Allard HA. 1920. Effect of the relative length of the day and night and other factors of the environment on growth and reproduction in plants. *J.Agri. Resch* 18: 553-506.

Khokhar KM, Hadley P, Pearson S. 2007. Effect of photoperiod and temperature on inflorescence appearance and subsequent development towards flowering in onion raised from sets. *Sci. Horticult.* doi:10.1016/j.scienta.2006.12.009.

Krontal Y, Kamenetsky R, Rabinowitch HD. 2000. Flowering physiology and some vegetative traits of short-day shallot: a comparison with bulb onion. *J. Hort. Sci. Biotech.*75 (1):35-41.

Lancaster JE, Triggs CM, De Ruiter JM, Gandar PW. 1996. Bulbing in onions: photoperiod and temperature requrements and prediction of bulb size and maturity. *Annals botany* 78:423-430.

Lee R, Baldwin S, Kenel F, McCallum J, Macknight R. 2013. Flowering locus T genes control onion bulb formation and flowering. Nature communication 4: 2884. DOI: 10.1038/ncomms3884.

Okubo H, Arifin NS, Miho N. 1999. Bulbing response of shallot (Allium cepa L. Ascalonicum Backer) and Allium × wakegi Araki to daylength and temperature. *J. Japan. Soc. Hort. Sci.* 68 (2): 283-285.

Putrasamedja S, Permadi AH. 1994. Pembungaan beberapa kultivar bawang merah di dataran tinggi. *Bul.Penel.Hort.* 26(4) : 145-150.

Putrasameja S, Suwandi. 1996. *Varietas bawang merah di Indonesia*. Monograf. Bandung (ID): Balai Penelitian Tanaman Sayuran.

Rabinowitch HD, Currah L. 2002. *Allium crop science: Recent advances*. London (GB): CABI Publishing.

Rachmat M, Sayaka B, Muslim C. 2012. *Produksi, Perdagangan dan Harga Bawang Merah*. Bandung (ID): Balai Penelitian Tanaman Sayuran.

Rosliani R, Palupi ER, Hilman Y. 2013. Pengaruh benzilaminopurin dan boron terhadap pembungaan, viabilitas serbuk sari, produksi, dan mutu benih bawang merah di dataran rendah. *J Hort.* 23(4): 339-349.

Sopha GA, Widodo WD, Poerwanto R, Palupi ER. 2014. Photoperiod and giberelin effect on true shallot seed formation. *AAB Bioflux* 6: 70-76.

Suherman R, Basuki RS. 1990. Strategi luas usahatani bawang merah (Allium cepa var ascalonicum) di Jawa Bali. Tinjauan dari Segi Usahatani Terendah. *Bul. Penel. Hort* 28 (3) : 11 – 18.

Sumarni N, Hidayat A. 2005. Panduan Teknis Budidaya Bawang Merah. Bandung (ID): Balai Penelitian Tanaman Sayuran.

Sumarni N, Sopha GA, Gaswanto R. 2012. Perbaikan pembungaan dan pembijian beberapa varietas bawang merah dengan pemberian naungan plastic transparan dan aplikasi asam gibberelat. *J. Hort* 22 (1):14-22.

Sutoyo. 2011. Fotoperiode dan Pembungaan Tanaman. *Buana Sains* 11 (2): 137-144.

Wu C, Wang M, Dong Y, Cheng Z, Meng H. 2016. Effect of plant age and vernalization on bolting, plant growth and enzyme activity of garlic (*Allium sativum* L.). *Sci. Hort.* 295-305.

Yamazaki H, Hamano M, Yamato Y, Miura H. 2003. Bulbing response of Allium × wakegi Araki to temperature experienced prior to bulb formation. *J. Japan. Soc. Hort. Sci.* 72 (1):69-74.