Detection of Flowering Ability on Several Bulbs Shallot Sources by using Hd3a and Endogenous GA₃ Analysis

E.Triharyanto, D. Purnomo, A. Yunus, Samanhudi

ABSTRACT
Background: Problems shallot cultivation in tropical regions such as Indonesia, is low productivity. Planting material is one of the causes of low productivity. The planting material used is a bulb that has been used continuously. It is makes planting material susceptible to infectious diseases and viruses. Efforts can be made to reducing the attack of virus infections in the planting material of the bulbs is by using seeds. However, seed production in Indonesia is still low due to the difficulty of flowering and low viability of seeds. The aim of this research was to detect flowering ability from the source of bulbs flowering and non-flowering clumps using Hd3a primers and endogenous GA₃, also the effect of age of bulbs to flowering of shallot.

Methods: The study used a complete randomized block design. The treatment consisted of two factors with three replications. The first factor was source of bulbs flowering and non-flowering clumps. The second factor was age bulbs which consists of three levels, namely the 60, 80 and 90 days age bulbs. The contents of gibberellins was analyzed using HPLC analysis. Molecular analysis to determine the potential of flowering genes used SSR primer (Hd3a).

Result: Hd3a primer can be used as a marker of flowering shallot. Source of bulbs flowering and non-flowering clumps have the same flowering potential gene. The percentage of flowering in flowering clumps was higher than non-flowering clumps and correlates with endogenous gibberellins content. The age of bulbs indicates that older bulbs gave a higher percentage of flowering.

Key words: Age of planting material, Bulbs production, Percentage of flowering.

INTRODUCTION
Shallots are one of the horticultural commodities with a requirement that always increases every year, but not always followed by increased productivity. Shallots productivity in Indonesia in 2014-2018 has decreased significantly (Statistical Yearbook of Indonesia 2018). The decrease of shallots productivity in 2018 reached 6.2% compared to 2014. One of causes the reduction in shallots production is the declining quality of the planting material used. The planting material used is a bulb that has been used continuously without any purification treatment. It is makes planting material susceptible to infectious diseases such as Fusarium sp. and viruses. Latent Shallot and Onion Yellow Drawl Virus (OYDV) significantly infect planted bulbs used. The disease causes a decrease in productivity up to 60% (Brewster 2008; Fletcher et al. 1998).

Efforts can be made to reducing the attack of virus infections in the planting material of the bulbs is by using seeds. The use of seeds as planting material will minimize transmission of viruses from previous generations (Triharyanto and Purnomo 2014). On the other hand the use of seeds is more efficient because it only requires about 1.5 kg per ha of shallots seeds. However, seed production in Indonesia is still low due to the difficulty of flowering and low viability of seeds produced (Triharyanto et al. 2013). This is because pollination of shallot can only occur with the help of insects (Devi et al. 2015). According to Chandel et al. (2004), induced bee pollination increased seed yields 2.5 times and produced an average of 971 seeds per umbel compared with 406 in controls. Environmental factors such as temperature, photoperiod and rainfall will effect the flowering process of shallots (Triharyanto et al. 2018). Shallots are two-season plants and long-day plants that can flower in cold temperatures (<18°C) with photoperiods> 12 hours (Sumarni et al. 2013), whereas in lowlands temperatures are relatively high (> 29°C) with photoperiods less than 12 hours of shallot is difficult to flowering. According to Tabor et al. (2006) shallots can flower at 6°C or 12°C with a 16-hour photoperiod. Short photoperiods can delay flowering, but long photoperiods can increase flowering in sub-tropic shallot and garlic (Khokar et al. 2007; Mathew et al. 2011). Long photoperiods can cause shallot flowering more quickly and simultaneously (Lewis 2003). However, the response to irradiation can differ between species and varieties.

In Indonesia, the function of cold temperatures can be replaced with vernalization treatments (cold temperatures) or growth regulators namely gibberellins which can...
specifically replace the function of cold temperatures to induce flowering. Plant growth substances are known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates, thereby helping in effective flower formation, fruit and seed development and ultimately enhance the productivity of crops (Sathishkumar et al. 2020). Gibberellins is known to play an important role in physiological processes during plant growth (Davies 2004). The role of GA\textsubscript{1} in the flowering process has been proven by the flowering pathway of GA\textsubscript{3} (Gibberellin pathway) (Sponsel 2005; Blazquez et al. 1998; Bernier and Perilleux 2005; Amasino and Michaels 2010). Besides the gibberellins pathway, it is explained that the flowering process can also be by sucrose pathway. The percentage of low flowering is associated with low carbohydrate levels (Ito et al. 2002). Shallots basically have inactive gibberellin hormones and in limited quantities depending on the variety kind.

In addition to environmental factors, flowering of a plant is significantly affected by genetic factors. Planting shallots from flowering clumps are expected to make higher flowering. To prove this, flowering detection is needed using primary Hd3a and endogenous GA\textsubscript{3} content analysis. Hd3a is a homologous flowering locus T (FT) which is a “fluorine”. FT in paddy which is a Hd3a homologue interacts with protein 14-3-3 which is in apical stem cells that encourage flowering inventions (Taoka et al. 2011). Hd3a is an RNA that is closely related to flowering time (Takahashi et al. 2009, Taoka et al. 2011, Osugi et al. 2011). Hd3a is very related to Ehd1 and RFT1 RNA in encouraging flowering initiation (Takahashi et al. 2009, Osugi et al. 2011). Primary utilization of Hd3a from paddy is expected to be used as a marker of flowering genes in shallots. The aim of this research was to detect flowering ability from the source of bulbs flowering and non-flowering clumps using Hd3a primers and endogenous GA\textsubscript{3}, also the effect of age of bulbs to flowering of shallot.

**MATERIALS AND METHODS**

Testing the origin and age of the shallots bulb planting material on flowering was carried out in Ngringo Village, Jaten District, Karanganyar Regency with a height of 98 m above sea level and soil type vertisol. The study was conducted in the rainy season (out season). The ingredients used were Bima variety shallot bulbs, organic fertilizer, inorganic fertilizer (ZA, SP-36, KC1). The study used a Complete Randomized Block Design (RCBD) with three replications. The treatment consisted of two factors, namely the source of seed bulbs [flowering clump bulbs (RB) and non-flowering clumps (RTB)] and the age of seed bulbs [60 (U60), 80 (U80) and 90 (U90) Days After Planting (DAP)]. Gibberellins and molecular analysis of flowering potential were carried out at Central Laboratory of Gadjah Mada University, Yogyakarta. The contents of gibberellins was analyzed using HPLC analysis (Barendse et al. 1980). Molecular analysis to determine the potential of flowering genes was carried out in several stages: first, DNA extraction from 5 samples of flowering clumps and 5 samples of non-flowering clumps, second, PCR 10 of these bulb samples used one SSR primer (Hd3a), third, electrophoresis from PCR results, fourth, documentation of electrophoresis results using a UV-transluminator (Sulistijowati and Mile 2016).

Observation variables included the percentage of flowering; bulb weight per clump; bulb weight per ha; bulb diameter, number of bulb per clump; and endogenous GA\textsubscript{3} content also flowering gene potential through molecular analysis with primary Hd3a. Data analysis used analysis of variance with 95% confidence level and continued with Duncan’s Multiple Range Test (DMRT).

**RESULTS AND DISCUSSION**

**Percentage of flowering**

Sources of planting material from flowering and non-flowering clumps show percentage of flowering not significantly different (Table 1). This proves that both flowering and non-flowering clumps have the same flowering potential. Percentage of flowering are supported by the results of molecular analysis which indicate that genetically the origin of the bulbs from flowering and non-flowering clumps has the same flowering gene (Fig 1). However, the percentage of flowering in both clumps was relatively low. The percentage of flowering in the flowering clumps was 9.73% and in the non-flowering clumps was 7.66%. Hd3a is a homologous flowering locus T (FT) which is a “fluorine”. FT in paddy which is a Hd3a homologue interacts with protein 14-3-3 which is in apical stem cells that encourage flowering initiations (Taoka et al. 2011). Hd3a is an RNA that is closely related to flowering time (Takahashi et al. 2009, Taoka et al. 2011, Osugi et al. 2011). Primary utilization of Hd3a from paddy is expected to be used as a marker of flowering genes in shallots. The aim of this research was to detect flowering ability from the source of bulbs flowering and non-flowering clumps using Hd3a primers and endogenous GA\textsubscript{3}, also the effect of age of bulbs to flowering of shallot.
Detection of Flowering Ability on Several Bulbs Shallot Sources by using Hd3a and Endogenous GA$_3$ Analysis

![Image](image.png)

Fig 1: Results of molecular analysis to flowering potential.

Table 1: Effect source and age of planting material and to flowering.

| Treatments                        | Source of Planting Material | Percentage of Flowering (%) | Bulb Weight (g) | Bulb Weight per Ha (ton) | Bulb diameter (cm) | Number of Bulb |
|-----------------------------------|-----------------------------|----------------------------|-----------------|--------------------------|-------------------|---------------|
|                                   | flowering clumps            | 9.7                        | 32.5            | 6.1                      | 2.4               | 6.2           |
|                                   | non flowering clumps        | 7.7                        | 39.6            | 7.4                      | 2.8               | 7.0           |
| Age of Planting Material          | 60 Days after planting      | 5.9a                       | 34.1            | 8.5                      | 2.3               | 6.2           |
|                                   | 80 Days after planting      | 9.4b                       | 36.8            | 9.2                      | 2.6               | 6.3           |
|                                   | 90 Days after planting      | 10.8b                      | 37.2            | 9.3                      | 2.8               | 7.3           |

Explanation: the numbers in the column followed by the same letter are not significantly different based on Duncan's test of 5%. RB = Flowering Clump, RTB = Non Flowering Clump.

and Zevenbergen 1992; De Hertogh and Zimmer 1993; Rabinowitch 1985; 1990; Kamenetsky 1994). One that describes the physiology of plants is the age of the bulbs. Krontal et al. (2000) observe that shallots have physiological age of tubers to flowering and increase the percentage of flowering. Age of planting material significantly affected the percentage of flowering. Yield of bulbs at 60 DAP lower (5.9%) compared to shallots from bulbs age 80 and 90 DAP, respectively 9.4% and 10.8%. It is due to the bulb yields of 80 and 90 DAP have higher glucose content than bulbs yielded at 60 DAP. The results of this study are in line with the results by Khan et al. (2019) that the initiation of garlic flowering is strongly influenced by the age of planting material, i.e. the older age of planting material shows a higher percentage of flowering. This is due to the flowering pathway which is significantly affected by the content of sucrose (suksrose pathway) (Sponsel 2005). The percentage of low flowering is associated with low carbohydrate levels (Ito et al. 2002), because cell proliferation before flowering requires the release of compounds that supply energy (Bernier 1981).

Endogenous GA$_3$ content

In addition to genetic factors, the initiation of flowering of genus Allium is affected by internal factors such as plant growth hormones and nutrients. One of the hormones that encourage flowering is GA$_3$ through mechanisms manipulation of long-day (Rashid and Singh 2000), because shallots are long-day plants that require irradiation> 12 hours (long day plants) (Rabinowitch and Kamenetsky 2002). The results of this study indicated that shallots have endogenous gibberellins (Table 2). The results of gibberellins analysis when flowering showed that flowering clump had higher GA$_3$ content than non-flowering clump (759.18 ppm: 668.86 ppm). On the other hand, GA$_3$ content in shallots after harvest showed that flowering clump had lower GA$_3$ content compared to non-flowering clump (39.09 ppm: 50.81 ppm) (Table 2). Endogenous gibberellins content after harvest was decreased. This shows that the demand for gibberellins for flowering initiation is quite high. According to Sumarni et al. (2013) that the potential for flowering shallot is affected by an increase in gibberellins. This shows that shallot can flower if it contains endogenous GA$_3$ with sufficient concentration. Research on Arabidopsis thaliana proved that short day conditions and lack of endogenous GA$_3$ concentrations cause non flowering (Wilson et al. 1992; Blazquez et al. 1998). If GA$_3$ deficiency occurs on long days cause late in flowering (Blazquez et al. 1998).

The content of gibberellins correlates with shallots percentage of flowering (Table 3). The correlation between gibberellins content with percentage of flowering in flowering
and non-flowering clumps showed a positive correlation with very high values (0.975 and 0.991). However, the correlation that occurs in the gibberellins content at harvest in the flowering clumps was still high, 0.920 and there was a decrease in the correlation value in the non-flowering clumps at 0.744. These results indicate that the gibberellins content at flowering and the percentage in flowering clumps were higher than non-flowering clumps. The role of GA affects the SOC1 gene. Furthermore, SOC1 will affect LFY gene which will affect flowering (Blazquez et al. 1998; Yu et al. 2004; Bernier and Perilleux 2005; Sponsel 2005). GA and Hd3a affect flowering, namely GA directly affects SOC1 gene, while Hd3a directly affects FT, then FT affects SOC1 gene. SOC1 gene affects LFY which is a gene driving flowering of a plant (Sponsel 2005). According to Shiraiwa et al. (2011) that there are 13 non-hydroxylation pathways of the dominant GA biosynthesis in shoots with GA3 playing an important role in the growth of garlic flowers. Gibberellins has an important role in the physiological processes during plant growth, one of which is the elongation of flower stalks (bolting) (Davies 2004). The next role of GA3 with adequate climatic conditions causes flowering of shallot. The role of GA3 is a very important factor in stimulating the flowering of shallots.

**Bulb weight**

The source of planting material did not significantly affect the bulb weight (Table 1). The bulb weight in flowering clumps (39.6 g) showed higher than non-flowering clumps (39.6 g). The age of the planting material also did not affect the bulb weight (Table 1). This was proved in the results of observations of bulb weight that bulbs at 80 and 90 DAP (Days after planting) expected have higher weight (Table 1). The results of this study are supported by Atif et al. (2020) that 80 DAP bulbs planting material improve the characteristics of bulbs, that is on 80 DAP (Days after planting) bulbs planting material producing bulbs in large quantities with large sizes.

**Bulb diameter**

The results showed that the source of planting material and the age of planting material did not significantly affect of bulb diameter (Table 1). The diameter of the bulb at the source of planting material of non-flowering clumps shows a higher yield of 2.8 cm. Whereas the flowering clump was 2.4 cm. In addition to environmental factors, this is due to the large bulbs influenced by genetic factors. Based on the results of the determination of each shallot variety showed different bulb size (Azmi et al. 2011).

**Number of bulb**

Source of planting material and age of bulb did not affect the number of bulb (Table 1). The source of flowering clumps (7.0 tubers) shows a high number of bulbs compared to non-flowering clumps (6.2 bulbs). This is because at the time of flowering the flowering clumps have higher endogenous gibberellins (Table 2). Oktaviani et al. (2020) stated that gibberellins are able to increase the yield of shallot bulbs. Gibberellins are able to increase cell size and the number of cells that cause cell division, increase the size and number of cells which ultimately increases the yield of shallots (Amiri et al. 2017). In addition, gibberellins have stimulated cell growth because this hormone functions to increase the hydrolysis of starch, fructant and sucrose into glucose and fructose molecules. But according to Raveendra et al. (2014) each genotype has a different response to gibberellins. The age of 90 DAP soil materials indicates a higher number of bulb (Table 1). This result is in line with Saharuddin et al. (2018) that the age of planting material influences the tuber yield.

**CONCLUSION**

Hd3a primer can be used as a marker of flowering shallot. Source of bulbs flowering and non-flowering clumps have the same flowering potential gene. The percentage of flowering in flowering clumps was higher than non-flowering clumps and correlates with endogenous gibberellins content. The age of bulbs indicates that older bulbs gave a higher percentage of flowering. Source and age of planting material do not affect on shallot yield.

**REFERENCES**

Amasino, R.M., Michaels, S.D. (2010). The timing of flowering. J. Plant Physiology. 154: 516-520.
Amiri, A., Kafi, M., Jari, S.K., Matinzadeh, M. (2017). Morphology and responses of Tulipa gesneriana L. to light quality in combination with GA and cold storage time. Indian J. Agric. Res. 51 : 568-573

Atif, M.J., Amin, B., Ghani, M.I., Ali, M., Cheng, Z. (2020). Variation in morphological and quality parameters in garlic (Allium sativum L.) bulb influenced by different photoperiod, temperature, sowing and harvesting time. Plants. 9: 1-15

Azmi, C., Hidayat, I.M., Wijguna, G. (2011). Effect of variety and size of bulbs on shallot productivity. J. Hort. 21: 206-213.

Barendse, G.W.M., Van de Werken, P.H., Takahashi, N. (2015). The pollinaton (Burm.) Nak. cultiva of Plants pollination: a missing dimension in physiology of ower bulbs. Elsevier, Amsterdam

Berghoef, J.L. (2018). Gibberellins promote flowering of arabidopsis by activating the leafy promoter. J. Plant Cell. 10: 791-800.

Brewster, J.L. (2008). Onions and other vegetable. Inter J Agri Ecol. 6: 265-271.

Chandel, R.S., Thekur, R.K., Bhadrwaj, N.R. and Parthania, N. (2004). Onion seed crop pollination: a missing dimension in mountain horticulture. Acta Hort. 631: 79-86

Cottignies, A., Cohat, J., Le Nard, M., Hourmant, A. (1997). Cycle cultural et floraison de l’échalote, Allium cepa L. var aggregatum (ovs. ‘Mikor’ et ‘Jermor’). Acta Botanica Galilica. 144: 19-16.

Davies, P.J. (2004). Plant hormones: Biosynthesis, signal transduction, action. 3ed. Klüwer Academic Publishers, Dordrecht.

De Hertogh, A.A., Zimmer, K. (1993). Allium: ornamental species. In: The physiology of ower bulbs. Elsevier, Amsterdam, The Netherlands.

Devi, S., Gulati, R., Tehri, K., Poonia, A. (2015). The pollination biology of onion (Allium cepa L) - A Review. Agri. Review. 36: 1-13.

Fletcher, P.H., Fletcher, J.D., Lewthwaite, S.L. (1998). In vitro elimination of onion yellow dwarf and shallot latent viruses in shallots (Allium cepa var. ascalonicum L.). New Zealand Journal of Crop and Horticultural Science. 26: 23-26.

Ito, A., Hayama, H., Kashimura, Y. (2002). Sugar metabolism in buds during flower bud formation: a comparison of two Japanese pear [Pyrus pyrifolia (Burm.) Nak.] cultivars possessing different flowering habits. Scientia Horticulturae. 96: 163-175. DOI:10.1016/s0304-4238(02)00122-x

Kamenetsky, R. (1994). Life cycle, ower initiation and propagation of the desert geophyte Allium rothii. International Journal of Plant Science. 155: 597-605.

Khan, N.H., Khan, S.M., Khan, N.U., Khan, A., Farid, A., Khan, S.A., Ali, N., Saed, M., Hussain, Ali, S. (2019). Flowering initiation in onion bulb crop as influenced by transplanting dates and nitrogen fertilizer. J. Anim. Plant Sci. 29(3): 772-782.

Khomrak, K.M., Hadley, P., Pearson, S. (2007). Effect of cold tempe-rature durations of onion sets in store on the incidence of bolting, bulbing and seed yield. Sci. Hortic. 112: 16-22.

Krontal, Y., Kamenetsky, R., Rabinowitch, H.D. (2000). Flowering physiology and some vegetative traits of short-day shallot: A comparison with bulb onion. The Journal of Horticultural Science and Biotechnology. 75: 35-41. http://dx.doi.org/10.1080/14620316.2000.1151197.

Lee, R., Baldwin, S., Kenel, F., McCallum, J., Macknight, R. (2013). Flowering locus T genes control onion bulb formation and flowering. Nat. Commun. 4: 2884.

Lewis, J.D., Wang, X., Kevin, L., Griffin., David, T. (2003). Age at flowering differentially affects vegetative and reproductive responses of a determinate annual plant to elevated carbon dioxide. Oecologia. 135: 194-201. DOI 10.1007/s00442-003-1186-7.

Mathew, D., Forer, Y., Rabinowitch, H.D., Kamenetsky, R. (2011). Effect of long photoperiod on the reproductive and bulbing processes in garlic (Allium sativum L.) genotypes. Environmental and Experimental Botany. 71: 166-173. doi: 10.1016/j.envexpbot.2010.11.008.

Messiaen, C.M., Cohat, J., Leroux, J.P., Pichon, M., Beyles, A. (1993). Les Allium alimentary reproduire par via vegetative. INRA, Paris, France.

Oktaviani, Z., Hayati, M., Kesumawati, E. (2020). The response of shallot (Allium ascalonicum L.) growth and yield to gibberelline concentration and the interval of NASA liquid organic fertilizer. IOP Conf. Series: Earth and Environmental Science. 425: 012071. doi:10.1088/1755-1315/425/1/01207.

Osugi, A., Itohm, H, Ikeda-Kawakatsu, K., Takano, M., Izawa, T. (2011). Molecular Dissection of the Roles of Phytocrome in Photoperiodic Flowering in Rice. J. Plant Physiology. 157: 1128-1137.

Rabinowitch, H., Kamenetsky, R., (2002). Shallots (A. cepa Aggregation group). In: Allium Crop Science: Recent Advances. [Rabinowitch, H.D., Currah, L. (Eds.)], CAB International, Wallington, UK, pp. 409-430.

Rabinowitch, H.D. (1985). Onions and other edible Alliums. In: CRC Handbook of Flowering. (Haley, A.H., Ed.). CRC Press Inc., Boca Raton, Florida, USA.

Rabinowitch, H.D. (1990). Physiology of flowering. In: Onions and allied crops. I. Botany, physiology and genetics. (Rabino-witch, H.D. and Brewster, J.L., Eds.), CRC Press, Boca Raton, Florida, USA.

Rashid, M.A., Singh, D.P. (2000). A Manual on Vegetable Seed Production in Bangladesh. Horticulture Research Center, Bangladesh.

Ravendra, Y.C., Shirol, A.M., Kulkarni, B.S. (2014). Influence of gibberellic acid on growth, yield and quality of daisy (Aster amellus L.) genotypes. Indian J. Agric. Res. 48: 319-323.

Saharuddin., Dungga, N.E., Syam’un, E., Amin, A.R. (2018). Towards Sustainable Agriculture: Growth and Productivity of Three Varieties of Shallot with Some Various Nitrobacter Biofertilizer Concentrations. IOP Conf. Series: Earth and Environmental Science. 157: 012015. doi :10.1088/1755-1315/157/1/012015.
Detection of Flowering Ability on Several Bulbs Shallot Sources by using Hd3a and Endogenous GA, Analysis

Sathishkumar, A., Sakthivel, N., Subramanian, E., Rajesh, P. (2020). Foliar spray of salicylic and gibberellic acid on productivity of crops: A Review. Agricultural Reviews. 41: 85-88.

Shiraiwa, N., Kikuchi, K., Honda, I., Shigyo, M., Yamazaki, H., Tanaka, D., Tanabe, K., Ita, A. (2011). Characterization of endogenous gibberellins and molecular cloning of a putative gibberellin 3-Oxidase gene in bunching onion. J. Amer. Soc. Hort. Sci. 136: 382-388.

Sponsel, V. (2005). Effect of GAs on Flowering. Plant Physiology Online, Chapter 20 Topic 8. http://5e.plantphys.net. Accessed October 18, 2019.

Statistical Yearbook Of Indonesia. (2018). 1st Ed. Edited By Sub Directorate of Statistics Publication and Compilation. BPS-Statistics Indonesia. Online, Jakarta. https://www.bps.go.id/Publication/2018/07/03/5a963c1ea9b0fed6497d0845/Statistik-Indonesia-2018.Html.

Sulistijowati, R.S., Mile, L. (2016). Identification of lactic acid bacteria isolates from intestine of milkfish (chanos-chanos) potential activity against pathogen bacteria used PCR 18s rRNA method. Internasional Journal of Bio-Science and Bio-Technology. 8: 127-134. http://dx.doi.org/10.14257/ijbsbt.2016.8.3.13.

Sumarni, N., Suwandi., Gunani, N., Putrasamedja, S. (2013). Effect of varieties and GaA application methods on flowering and true seed yield of shallots in South Sulawesi. J Hort. 23: 153-163.

Tabor, G., Stuetzel, H., Zelleke, A. (2006). Influence of planting material and duration of vernalization on bolting of shallot (Allium cepa L. var. ascalonicum Backer). J. Hortic. Sci. Biotechnol. 81: 797-802.

Takahashi, Y., Teshima, K.M., Yokoi, S., Innan, H., Shimamoto, K. (2009). Variations in Hd1 proteins, Hd3a promoters and Ehd1 expression levels contribute to diversity of flowering time in cultivated rice. PNAS Early Edition. 1-6.

Taoka, K., Ohki, I., Tsuji, H., Furuita, K., Hayashi, K., Yanase, T., Yamaguchi, M., Nakashima, C., Purwestri, Y.A., Tamaki, S., Ogaki, Y., Shimada, C., Nakagawa, A., Kojima, C., Shimamoto, K. (2011). 14-3-3 proteins act as intracellular receptors for rice Hd3a florigen. J. Nature. 476: 332-338.

Triharyanto, E., Nyoto, S., Yusriani, I. (2018). Application of gibberellins on flowering and yield of two varieties of shallot in lowland. IOP Conference Series: Earth and Environmental Science. 142: 012 066.

Triharyanto, E., Purnomo, D. (2014). Study of viability and seed structure of shallot. J. Agric. Sci.Tec. 4: 121-5.

Triharyanto, E., Samanhudi., Pujiasmanto, B., Purnomo, D. (2013). Study of seedling and cultivation of shallots (Allium ascalonicum L.) through botanical seed (True Shallot Seed). Paper Presented at the National Seminar of the Faculty of Agriculture, UNS Surakarta.

Wilson, R.N., Heckman, J.W., Somerville, C.R. (1992). Gibberellin is required for flowering in Arabidopsis thaliana under short days. J. Plant Physiology. 100: 403-408.

Yu, H., Ito, T., Zhao, Y., Peng, J., Kumar, P., Meyerowitz, E.M. (2004). Floral homeotic genes are targets of gibberellin signaling in flower development. PNAS. 101: 7827-7832.