

## The Possible Role of Exogenous Hormones In Influencing The Length and Dry Matter of Strawberry (*Fragaria x ananassa* Duch) Peduncle

<sup>1</sup>Isam Abdulbaset Haidar Al-madhagi, <sup>1</sup>Sayed M. Zain Hasan, <sup>2</sup>Aziz Ahmad, <sup>1</sup>Abdullah M.Zain and <sup>3</sup>Wan Abdullah Yusoff

<sup>1</sup>Faculty of Agrotechnology and Food Science, University Malaysia Terengganu (UMT), 21030 Kuala Terengganu, Malaysia.

<sup>2</sup>Faculty of Science and Technology, (UMT) University Malaysia Terengganu (UMT), 21030 Kuala Terengganu, Malaysia.

<sup>3</sup>Malaysian Agricultural Research and Development Institute (MARDI), Cameron Highlands, Pahang, Malaysia

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### ABSTRACT

Length and dry matter content of peduncle (stalk of inflorescence) are recognized as one of important factors in determining the fruit quality and efficient labour cost during harvesting in strawberry (*Fragaria x ananassa* Duch) production. A study was conducted at the Malaysian Agricultural Research and Development Institute (MARDI) Station in Cameron Highland, Malaysia with the aim at determining the effect of exogenous hormone on the length and dry matter content of strawberry peduncle. A two-factorial experiment with three replications was designed in randomized completed block design (RCBD) where two factors, cultivars and exogenous hormone were used. Two Cameron Highland commercial strawberry cultivars, Camarosa and Camaroga, were grown under rain shelter and treated with 0 and 50 ppm hormones of auxin (IBA), gibberellins acid (GA3) and cytokinin (6-BA) either singly or in combination by foliage application. The results showed that, there is a significant different of peduncle length between the two cultivars. The peduncle length, however, greatly increased by about 351% comparing with those in the control plants when applied with 50 ppm GA3 in singly without combined with the other hormones. Combined application of GA3+IBA had increased the dry matter content of peduncle by 15.4 % comparing with those in the control plants. The result also indicated that these two cultivars of strawberry gave a different response to the exogenous hormones on the length and dry matter content of peduncle. Result of the presence study could be used to control the length of strawberry fruit stalk accordingly for efficient harvesting and better fruit quality.

**Key words:** Strawberry, hormones, peduncle, dry matter.

### Introduction

Under the normal practice, harvesting of strawberry fruit is done manually by hand picking. Recently, the machine was introduced to harvest the strawberry fruits and this requires not only the cultivars with a high fruit firmness but also the plant with a long peduncle or inflorescence stalk. The use of harvesting machine requires an appropriate detection of peduncle of the targeted fruit, and in this case a long peduncle fruit could contribute to the success of the process [9]. However, almost all fruits that consume fresh are still preferably harvested by hand picking. The efficiency of hand picking is depending on the accuracy of eye observation on the

fruit that reduced when the fruit is covered by leaves due to the short fruit peduncle.

The strawberry inflorescence peduncle is a modified stem terminated by the primary flower [20]. Exposing a long size peduncle to the sunlight possibly raised the quality of fruits [18]. At the same time the long peduncle contributes to the greater number of epidermal cells indicating an increasing of photosynthesis in the peduncle (Nishizawa, 1994). It was also found that different cultivars have different peduncle length [4,8].

To date the effect of exogenous gibberellins on the length of peduncle has never been reported except the effect on the dry matter content. Paroussi *et al.*, [14] found that the length of inflorescence peduncle of three cultivars of strawberry

### Corresponding Authors

Isam Abdulbaset Haidar Al-madhagi, Faculty of Agrotechnology and Food Science, University Malaysia Terengganu (UMT), 21030 Kuala Terengganu, Malaysia.  
E-mail: isam.madhagi@gmail.com

(‘Camarosa’, ‘Laguna’ and ‘Seascape’) were positively affected by GA3. In addition, GA3 sprayed on the plant has forced the cultivars to open the flower earlier, hastened fruit maturation and increased peduncle lengths [10]. In the other experiment, Casto *et al.*, [3] demonstrated that the application of IAA and GA3 at 10 p.p.m. was facilitating the fruit picking due to the increase of the peduncle length. Although GA3 treatment produced an elongated peduncle [21], but high concentration of GA3 (200 mg L<sup>-1</sup>) caused marked inflorescence abnormalities, especially in Seascape cv. [14].

Additionally, the percentage of soluble solids in the flowering shoots varied according to the flower development. Cytokinin treatment promoted the inflorescence development and increased percentage of soluble solids in the inflorescence shoots [16]. Cytokinin significantly increased plant dry weight in tomato [11] while in another previous reports mentioned that cytokinin reduced the dry matter content [17].

Until now only a very small studies have been conducted to focus on the length and dry matter content of strawberry inflorescence stalk. In this study, the effects of exogenous hormone on the length and dry matter content of inflorescence peduncle of two commercial cultivars of strawberry (Camarosa and Camaroga cvs.) were determined.

## Materials and Methods

### 1.1. Planting Materials:

The experiment was conducted in the Malaysian Agricultural Research and Development Institute (MARDI) Station at Cameron Highland, Malaysia which located at an altitude of about 10,000 m above sea level, at 4°28'6.75"N and 101°23'6.83"E. Runner containing a small plantlet was taken from the mother plant of strawberry cvs. ‘Camarosa’ and ‘Camaroga’. After removing the root, the plantlets were grown in nursery until plants produced 3.5 leaves and then each subsequently transferred into a 15 cm diameter pot. Plants were then kept under the plastic rain-shelter house and arranged according to the RCBD factorial design with two factors. The plants were sprayed with three types of phytohormones; indolyl-3- butyric acid (IBA) (Merck, Germany), N-6-benzyladenine (BA) (R & M, UK), and GA3 (Merck-Schuchardt, Germany) with two levels of concentration, 0 and 50 ppm with single or combination of two or three phytohormones. Three replicates were used for each treatment and each replicates consist of five plants.

The temperature and humidity had been recorded daily using Thermo-Hygrograph. The fertilizer was supplied via the fertigation system. Length and dry matter content were measured from

the peduncles of the first inflorescence using three plants from each replicate. The peduncles were cut in between near the stem (crown) and near the first branch of inflorescence. Subsequently the peduncles were washed, freshly weighted and dried in the oven at 60° C until reached a consistent weight. Then the percentages of the dry matter were calculated as the following, % dry matter (DM) content = (Dry weight x 100) ÷ fresh weight.

### 1.1.1. Statistical analysis:

The data were analyzed as a factorial RCBD with an exogenous phytohormone factor and a cultivar (genetic) factor. Analysis of variance (ANOVA) was used to determine the significant difference among the treatments by using the program GinStat 12. The L.S.D and Multiple Range Test of Duncan for the significant means was calculated.

## 2. Result:

The peduncle length was significantly higher with about 49.77% longer in ‘Camaroga’ cv. than in ‘Camarosa’ (Figure 1). However, the differences of peduncle dry matter between the cultivars was not significant (Figure 2). This might be due to the fact that the two cultivars are the short day plant and genetically closely related.

The effects of exogenous phyto-hormones on the length of strawberry peduncle are shown in Figure 3. Plant applied with GA3 produce the longest peduncle than those of the other treatments with an increasing of about 351% of the control. Meanwhile there are no significant different of the peduncle length in the combined treatment of GA3 with the other hormones.

The effect of exogenous hormone on the peduncles dry matter content are shown Figure 4. The combination of GA3 + IBA had exhibited the highest dry mater content in the peduncle, but there are no significant differences among the treatments. The lowest dry matter content was given by 6-BA with single treatment, but there was no significant differences comparing with the other treatments. The effect of exogenous hormone on the peduncle length was also depended on the plant cultivars. A combination of GA3+6-BA+IBA gave the greatest length of peduncle in ‘Camaroga’ cv, whereas GA3 as single treatment produced the longest peduncle in ‘Camarosa’ cv. (Figure 6).

Figure 6 shown the effect of interaction between exogenous phyto-hormones and cultivars on the dry matter content of strawberry peduncle, where there are no significant was found among all treatments on Camarosa cv, except a more vigorous content was found in the ‘Camaroga’ cv than those in the ‘Camarosa’ cv.

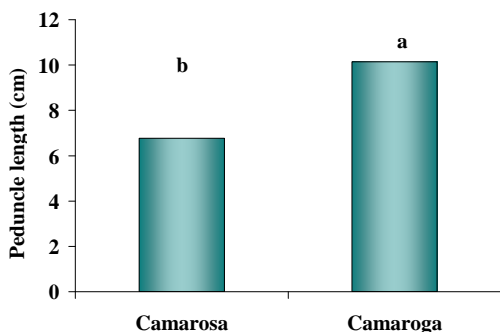


Fig. 1: Means comparisons for the effect of cultivars on the length (cm) of strawberry peduncle.

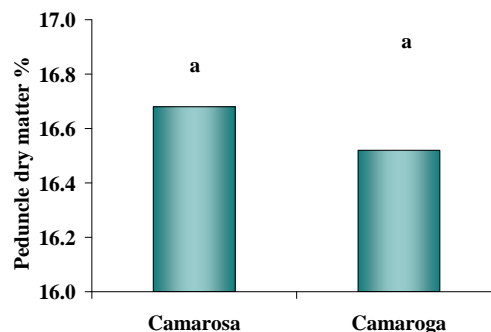


Fig. 2: Means comparisons for the effect of cultivars on the dry matter content (%) of strawberry peduncle.

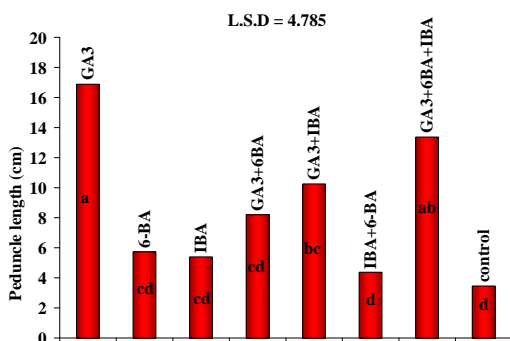


Fig. 3: Means comparisons for the effect exogenous hormone on the length (cm) of strawberry peduncle.

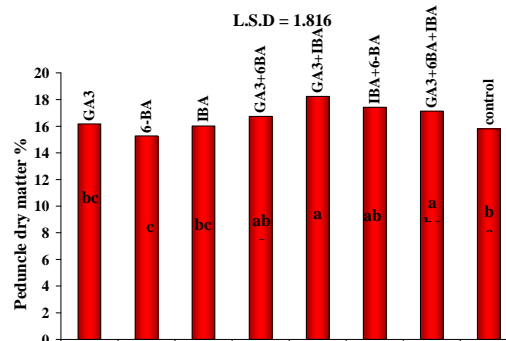


Fig. 4: Means comparisons for the effect exogenous phytohormones on the dry matter content (%) of strawberry peduncle.

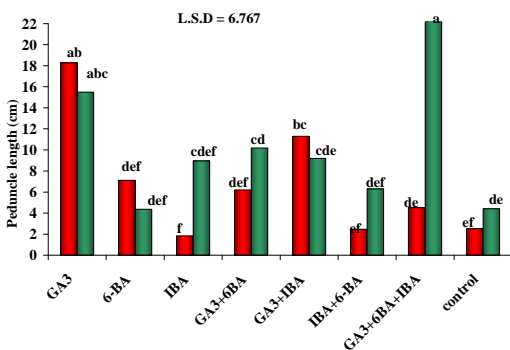


Fig. 5: Means comparisons for the interaction effect of exogenous phytohormone and cultivars on the length (cm) of strawberry peduncle.

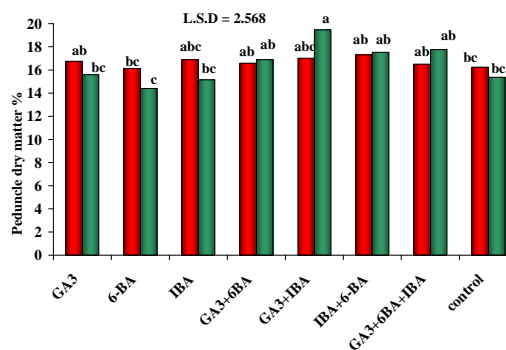


Fig. 6: Means comparisons for the interaction effect of exogenous hormone and cultivars on the dry matter content (%) of strawberry peduncle.

3. Discussion:

The result of this study clearly indicated that the GA3 had increased the length of the peduncle of strawberry. GA3, in fact, plays an important role in cell elongation [19], and in the extending of the peduncle length in this study may be attributed to the increasing number of epidermal cells by increasing of cell division [12]. Such effects, however, are much

depending on the cultivar of strawberry partly due to the genetic difference among the cultivars. ‘Camaroga’ cv. gave a greater length of peduncle when applied in combination with GA3+6BA+IBA, but oppositely, ‘Camarosa’ gave a shorter peduncle which explains that the response of cultivars to the exogenous hormone is dependent on the types of hormone, genetic and also the surrounding environment [6].

Furthermore, the cytokinins may inhibit or antagonized the role of gibberellins. The presence study demonstrated that there are no significant different among the treatments on the length and dry matter of the peduncle when applied with 6-BA alone, but it repressed the effect of GA3. These results was similar as found in tomato, where 6-BA had effected on GA3 response on the hypocotyls length [5]. But, unlike in *Arabidopsis*, where cytokinin has no effect on gibberellin action [7]. In the length and dry matter of the peduncle of strawberry, there is a reciprocal negative interaction was found, where cytokinin inhibits gibberellin action.

In contrast, the applied of 6-BA produces a lower dry matter content in the peduncle that may be due to the reduction of the soluble solids in the peduncle and shoots [16]. Additionally, cytokinin reduces the dry matter content in roots [17]. Apparently, the result of cytokinin treatment used in this study was almost closely similar with the result shown in the dry matter accumulation of wheat [2].

In this study, the combinations of GA3 with IBA which produced the greatest dry matter content in strawberry could be due to the stimulation of IBA on the enhancement of cell division and chlorophyll accumulation, and that led to the higher photosynthetic activity and accumulation of dry matter content in the plant. Amin *et al.*, [1] reported that foliar application with various concentration of IBA led to a significantly increase of dry matter content in onion, but in strawberry we found only the combination of GA3 with IBA could increases the dry matter of the peduncle.

It could be concluded that the application of combined GA3+IBA can induce the increase of strawberry peduncle dry matter content, and oppositely the application of 6-BA could reduce the dry matter content of the peduncle. Spray of GA3 as single treatment led to extend the peduncle length, while cytokinin may inhibit the role of gibberellin. Also, GA3 enhanced the IBA activity in increasing the dry matter content of the strawberry peduncle.

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