J. Agroland 15 (2) : 79 - 83, Juni 2008 ISSN : 0854 – 641X

TEMPERATURE AFFECTING THE FLOWERING OF STURT'S DESERT PEA (*Swainsona Formosa*)

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ABSTRAK

Sturt;s Desert Pea (SDP) adalah suatu tanaman legum. Tanaman ini berpotensi sebagai tanaman bunga dalam pot, juga cocok pada pot-pot gantung dan bunga potong. Keberhasilan secara komersial sangat tergantung pada produksi yang konsisten dari tanaman yang berkualitas. Tujuan penelitian ini adalah menemukan kondisi lingkungan yang sesuai untuk produksi tanaman. Faktor lingkungan yang diteliti adalah temperatur. Untuk mengetahui pengaruh temperatur pada pembungaan, maka penelitian dilakukan dengan mengatur temperatur pada 25°C konstan, temperatur 10°C malam dan 22°C siang, dan perlakuan ketiga tanaman ditumbuhkan pada temperatur 18°C malam dan 30°C siang. Hasil penelitian menunjukkan bahwa tanaman yang ditumbuhkan pada temperatur 18°C malam dan 30°C siang menghasilkan bunga lebih banyak dari perlakuan temperatur lainnya.

Kata kunci : Legum, pembungaan, temperatur**.**

I. INTRODUCTION

Sturt's Desert Pea, *Swainsona Formosa* (G.Don) J. Thompsons, formerly known as *Clianthus Formosa*, is a member of the sub-family papilionoideae and has large (up to 100 mm long) flog-shaped flowers consisting of an upper standard petal (flag) that commonly incorporates a shiny black boss, and lower keel that houses the sexual organs.

Successful commercialization of any new flowering plant relies on our understanding of the environmental conditions which affect flowering in those plants. SDP grown under unfavorable condition can produce only a few flowers (Williams and Taji, l991). Many factors, including environmental factors, influence the flowering. There are many examples of interaction between light intensity and temperature, particularly with respect to flowering (Salisbury, l963). Several researchers have studied the interaction between light intensity and temperature in various species. Takayo *et al* (l998) reported that high temperature (27 °C) caused a disappearance of the flowering potential of *Limonium sinuatum* plants growing under in vitro conditions, whereas low temperature 20 °C can restore the flowering. With respect to the effect of light intensity on flowering, Kinet *et al* (l985) reported that low light intensity reduces inflorescence development.

Although SDP flowers have been exported to Japan (Barth and Bennell, l989; Williams, l996) and indeed there is strong interest in SDP by Japanese buyers, to date its production as a commercial crop has been marred with difficulties, due partly to our lack of understanding of its flowering pattern. Therefore, the objective of the work reported here is to understand the light intensity and temperature requirement of SDP on its flowering habit.

II. MATERIALS AND METHODS

2.1. Plant Material

Seeds of SDP were germinated in Petri dishes at 25± 2 C using the Taji and Williams (l989) procedure. The germinated seeds were transferred to Jiffy 7 pots. The seedlings were transferred to a glasshouse with reduce light intensity (approximately 100-170 µmol $m^{-2}s^{-1}$) and placed under intermittent misting for 10 days for further growth, The well-established and uniform seedlings were transferred to 5L pots containing a pasteurized sand and peat mix (3:1). To each pot four grams of Nutricote, a slow release fertilizer (N:P:K = 16:4:4) was applied. Aquasol (17%N, 3%K, 4,5%S, and 3.3 % Mg) was added to each pot every two weeks.

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2.2. Growth Cabinet

This experiment was performed in three growth cabinets produced by Thermoline Australia. The growth cabinets were set at different temperatures. Light intensity in all cabinets was the same (between 150 μmol $m^{-2}s^{-1}$ to 1000 μmol $m^{-2}s^{-1}$) with photoperiod set at 12h day and 12h night. Four plant replicates were placed in each growth cabinet.

2.3. Plants Maintenance

Plants were watered manually according to need. Every two weeks, the plants were fertilised using a modified Aquasol solution.

To avoid root diseases, Fungorid™ (1g/L water) was applied twice during the experimental period.

Due to the presence of European red spider mite during this experiment, plants were sprayed with Omitte® 300W (1g/L water) applied when the mites appeared.

2.4. Temperature Experiment

This experiment was performed in three growth cabinets where the temperature was set at a constant 25 °C during both day and night, differential temperature of 10 °C night and 22 °C day, or 18 °C night and 30 °C day. Four plants (replicates) were placed in each growth cabinet. At the time of harvest, 87 days after germination, leaves of similar age were harvested from each replicate for chlorophyll determination following the methods of Bruinsma (l961). Time taken of the appearance of the first flower was recorded and the total number of flowers per plant was determined.

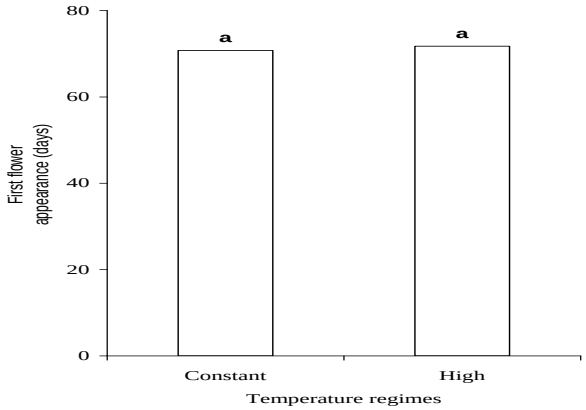

Figure 1. Effect of Temperature on the Time to The Appearance of The First Flower.

2.5. Chlorophyll and Anthocyanin Measurement

Leaves of similar ages were harvested for chlorophyll content determination using the method outline by Bruinsma (l961). Anthocyanin was measured using a Milton Range Spectrophotometer.

2.6. Statistical Analysis

Four plants were used as replication in each treatment. Data were analysed using Excel to determine significant differences; means were separated using the Duncan's Multiple Range Test (DMRT) at a 5 % level of significance.

III. RESULTS AND DISCUSSION

3.1. Result

a. First Flower Appearance

There were no significant differences in the time taken to the appearance of the first flower of SDP plants for plants grow under the constant temperature regime or high temperature regime. Plants grown under the low temperature regime did not produce any flowers during the experimental period of 87 days (Figure 1).

b. Number of Flowers

The number of flowers produced on SDP plants was affected by temperature. The highest mean number of flowers per plant (10.75 flowers) was produced on plants grown under high temperature regimes followed by constant temperature with 5.25 (Figure 2).

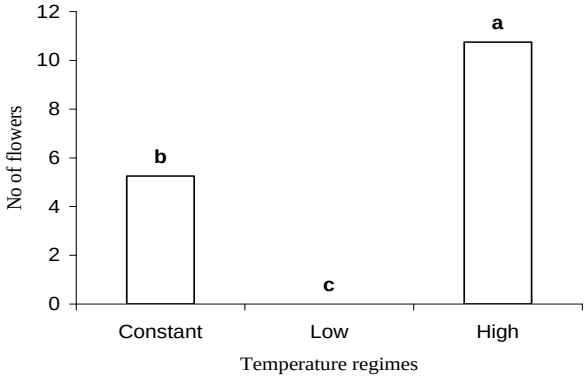

Figure 2. Effect of Temperature on the Number of Flowers per Plant.

c. Dry Weight of Plants

Figure 3 shows some differences between treatments in the dry weight of plants. The high temperature regime produced a greater dry weight of plants than the low and constant temperature regimes which had similar dry weights of plants.

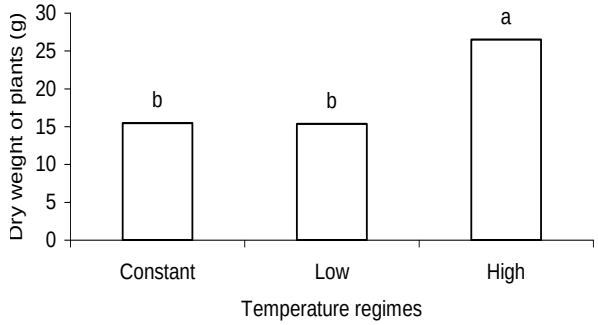

Figure 3. Effect of Temperature on the Dry Weight (g) of Sturt's Desert Pea Plant

d. Chlorophyll Content

Figure 4 shows some differences in chlorophyll content between treatments. Low temperature treated plants had a lower chlorophyll content than plants under constant or high temperatures. Both constant and high temperature treatments showed similar levels of chlorophyll.

e. Anthocyanin Content of Flowers

There were no significant differences in the anthocyanin content of flowers as a result of the temperature treatments (Figure 5.).

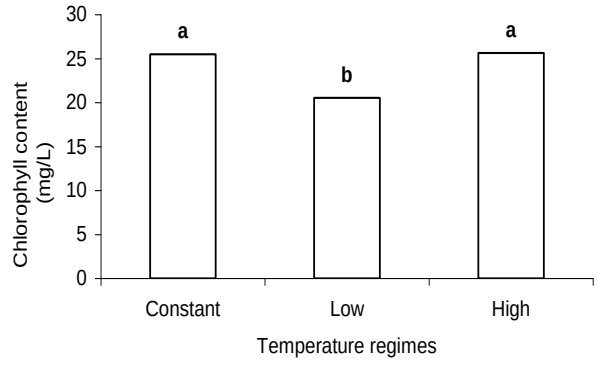

Figure 4. Effect of Temperature on the Chlorophyll Content (mg/L) of Sturt's Desert Pea

3.2. Discussion

a. First Flower Appearance

Temperature affected the time to the appearance of the first of SDP with the low temperature treatment (18 °C night/22 °C days) producing no flowers during the experimental period (87 days after seed germination). The high temperature regime produced flower at the same rate as the constant temperature regime. Low temperature appeared to increase the period of time taken to the appearance of the first flower of SDP; both constant and high temperature treatments promoted flower production. Our results are supported by the work of Park et al., (l998) with Balloon Flowers. They also found that there was a direct relationship between temperature and days of flowering.

The delayed time to flowering at the low temperatures suggests little evidence of a cold requirement for flower induction in SDP. Jusaitis and Schmerl (l993) found that the growth temperature of SDP had a marked effect on plants flowering. It was found that the time to first flower appearance decreased with the increase in temperature. Furthermore, Williams (l996) reported that SDP performs better at warmer temperatures (25-30 °C).

The reason for this delay in flowering may be due to low temperatures slowing down the various chemical reactions required for flowering development and growth (Edmond *et al.*, l975).

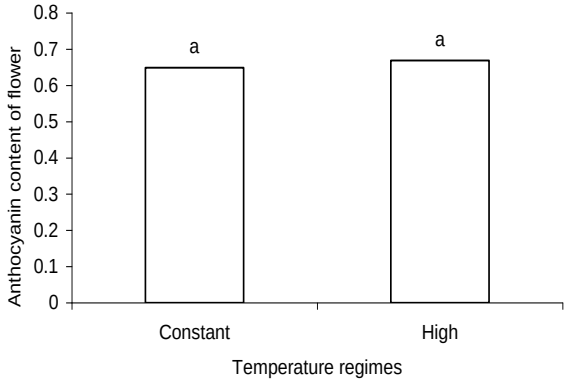

Figure 5. Effect of Temperature on the Anthocyanin Content of Flowers

b. Number of Flowers

The number of flowers produced was affected by temperature regimes. SDP plants produced more flowers when grown under temperatures 18 °C night/30 °C day. On the other hand, no flower appeared when grown under 10 °C night/22 °C day until 87 days after seed germination.

Fukai et al. (l999) reported that each species had a different requirement of minimum night temperature for flowering. Results here indicated that flowering in SDP is enhanced by higher temperatures. According to Edmond *et al*. (l975), during the night period the absorption of water is relatively high and the rate of transpiration is relatively low; as a result, turgor pressure for the elongation of new cells is high. Furthermore, there are two important events on the alternating day and night temperatures: production of abundant quantities of initial foods and related substances during the day, and elongation of new cells during the night. It is probable that SDP plants could not achieve these two important events in the low temperature treatment (10 °C night/22 °C day).

c. Dry Weight of Plants

The results here showed that the dry weight of plants grown under the high temperature regime was significantly higher than the dry weight for the constant and low temperature grown plants.

According to Edmond et al., (l975), a constant temperature on the lower part of the range for any given crop would be associated with low rates of gross photosynthesis, and low rates of growth. A constant temperature on the upper part of the range would be associated not only with high rates of gross photosynthesis, but also with excessively high rates of respiration.

In SDP, low temperature resulted in a reduction of dry weight indicating that photosynthetic rates of the plants were slow. In a constant temperature regime, where night temperatures have been high (25 °C compared with 10 °C for low differential temperature and 18 °C for high differential temperature) a high rate of respiration must have further reduced the dry matter accumulation due to high rate in respiration at night.

d. Chlorophyll Content

Figure 4 shows that the chlorophyll content of SDP plants grown under different temperature regimes was statistically different. The highest chlorophyll concentration was measured in SDP plants grown under the high temperature regime, the next highest for plants under constant temperature. The lowest amount of chlorophyll was measured in low temperature grown plants.

The literature suggests that photosynthesis, in conjunction with several other metabolic activities, takes place in cellular organelles called chloroplasts which are identified by the fact that they contain the chlorophyll pigments. Chloroplasts contain a complete genome, including DNA, RNA, and the enzymes necessary for protein biosynthesis (Hopkins, l995). As reported by Edmond et al. (l975), enzymes and other protein systems in plants were not maintained in low temperature regimes. Therefore, this may be one of the reasons why work reported here showed that plants grown under 10 °C night/22 °C day had lower chlorophyll content.

Another possibility is that temperature-induced effects may be related to changes in endogenous hormones in plants (Fouche *et al*., l977, Salisbury & Ross, l992). At low temperatures, the production of these endogenous hormones may be slow leading to reduction in the concentration. Cytokinin, for example, has been reported by some authors to increase the concentration of chlorophyll in chloroplasts (Ketring & Schubert, l981; Palni et al., l984; Kamoda et al., l995; Ohki & Sawaki, l998); this suggests that at low temperatures the low rate of cytokinin induces lower quantities of chlorophyll in SDP (Figure 4).

IV. CONCLUSION

This experiment showed that SDP plants grown under 18 °C night/30 °C day produced a high number of flowers and reduced the time taken to the appearance of the first flower. SDP plant grown under this condition seem to be able to enhance the profit margin for growers.

Therefore, so far as temperature requirement is concerned, it is recommended that for commercial production, SDP should be grown under 18 °C night/30 °C day conditions.

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Limonium sinuatum, 79 ***Swainsona Formosa***, 79