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Effect of a Hormone Containing Nitrobenzene in Combination with Fertilizers on Early Flower Induction of *Ixora coccinea* Hybrids Under Outdoor and Shaded Conditions

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Abstract: *Ixora* or Jungle Geranium (*Ixora coccinea*) is an invaluable plant in tropical landscapes for its beautiful foliage, easiness of growing and fabulous flowers freely formed and artfully presented. Sri Lanka exports *Ixora* hybrids as planting materials after rooting the *Ixora* cuttings on a coir dust media. Exporting potted *Ixora* plants with flowers is more beneficial than that without flowers as flowers increase product quality and gain customer attraction. In commercial floriculture venture, flower induction at young age using plant growth regulators and fertilizers is a popular practice. An experiment was conducted to investigate the most effective combination of a plant growth regulator and fertilizers for early flower initiation of *Ixora* hybrids; Vulcanus, Chanmai, Nora grant and Kontiki under outdoor and shaded conditions. Six-month-aged healthy plants of *Ixora* hybrids grown in containers were treated with a flowering hormone containing Nitrobenzene in combination with two fertilizer types: F1 – Bloom special and F2 – Krista K 44. Flowering hormone was sprayed in four concentrations; H1= 0.075% (V/V), H2 = 0.100% (V/V), H3 = 0.125% (V/V) and H4 = 0.150% (V/V) once in two weeks. Both fertilizers were applied as a liquid spray in same concentration (1 g/L of water) once a week. All the cultural practices were similarly applied to the plants under two light levels (outdoor light 'L1'and shaded conditions 'L2'). There were 16 treatment combinations and control, each with five replicates. Each treatment combination consisted of three plants. The number of flower-initiated plants per treatment combination was recorded as a percentage for five weeks. Percentage values after five weeks of treatments were transformed into log values and used for the analysis of variance. All the hybrids except Vulcanus showed a significant flower induction compared to the control. Outdoor light and shaded conditions were not significantly different to each other showing the potentiality of early flower initiation of hybrids under shaded condition. However, no significant difference in flower induction was observed among four levels of the flowering hormone and the two types of fertilizers ($p > 0.05$) in all four *Ixora* hybrids despite differences among the hybrids. Therefore, it could be concluded that the least expensive combination of hormone and fertilizer type could play a profitable and a positive role in early flower induction of *Ixora* at an age of six months.

Keywords: Floriculture, Ixora Coccinea, Nitrobenzene, Flowering Hormone, Flower Induction

1. Introduction

Ornamental crop culture, which was considered as an amateur or gardener activity, has now become an important and innovative business with a viable export potential [1]. Sri Lanka is recognized as one of the best quality production centers for floriculture products in the world as it is endowed with different climatic conditions caused by terrain enabling to develop floriculture products ranging from tropical to temperate flora. Floriculture industry has grown substantially during the last few decades to become the Sri Lanka's major foreign exchange generating venture [2].

Ixora (*Ixora coccinea*) hybrids are planted worldwide in tropical and subtropical climates [3]. There are over 400 species of *Ixora* and only a few of them are grown as landscape plants. One such species grown is *Ixora chinensis* or Chinese Ixora. This species offers many cultivars and many of which produce yellow to orange flowers. *Ixora coccinea* or Red Ixora is a popular species that bears orange-red flowers and reddish new growth. The *Ixora* hybrids, which are produced by crossing between species, account for the majority of *Ixora* plants used in landscapes. During the past many years, new *Ixora* hybrids differing in flower color, leaf size and plant height have appeared in the market due to the introduction and hybridization programs. *Ixora* is used in warmer climates for hedges and screens, foundation planting, massed in flowering beds and grown as a specimen shrub or small tree. *Ixora* is invaluable in tropical landscapes for its beautiful foliage, fabulous flowers that are freely formed and artfully presented and also for its easiness in management. In cooler climates, *Ixora* plants are grown in greenhouses or as a potted houseplant necessitating bright light.

Sri Lanka exports *Ixora* as planting materials after rooting of cuttings on coir dust media. Exporting potted *Ixora* plants with flowers is more beneficial than exporting young plants without flowers as flowers increase product quality and gain customer attraction. In Sri Lankan nurseries, *Ixora* hybrids are mostly grown in containers under shade nets. Therefore, natural flowering is very rare until the plants become matured. The regular pruning practice delays flowering of those plants as it removes emerging flower buds. Although a few plants initiate flowers, the flowering is not synchronized within the same aged plant groups.

Understanding the process of flower initiation is vital to growers as the plants have a great commercial and economic importance. Being able to control the flowering time, it enables growers to schedule crops to meet the demands of the market. However, it is a complex physiological process which requires a good deal of knowledge as different species respond to different stimuli to initiate flowering [4]. Plant growth substances change the flowering behavior of several plant species and their effects vary with plant species, age, concentration of the growth substance and temperature. Use of plant growth substances for flower induction -under environmental conditions which are not conductive to flowering- has considerable interest in agriculture. In addition to plant growth substances, growers should be able to control light and temperature as well in order to induce flowering. Naphthaleneacetic acid (NAA) and 6-Benzyladenine (BA) could play a big role in early flowering of *Ixora chinensis* [5].

As reported in [6], spraying of plant growth substances containing Nitrobenzene significantly increase the panicle production in wetland rice. Moreover, early flowering was achieved by 1% Nitrobenzene in Paprika cv.KtPl-19 [7]. Nitrobenzene is a combination of nitrogen and plant growth regulators extracted from sea weeds. Nitrobenzene, also known as Nitrobenzol or oil of mirbane, is an organic compound with the chemical formula $C_6H_5NO_2$. 'Elite' is a commercially available plant growth substance containing 20% (v/v) Nitrobenzene.

Although there are some literatures on induction of flowering in *Ixora* using different combinations of hormones and by controlling of light and temperature, no reported study is found to induce flowering of potted young *Ixora* plants. As the subject plants are very young, it was felt important to apply fertilizers in combination with the hormones to scaffold the growth of the plants. Since product quality of a flowering plant heavily depends on flowers, it is beneficial to induce flowering of potted young plants of *Ixora* by applying a combination of plant growth substances and fertilizers. This study investigates (1) the most effective combination of plant growth substances and fertilizers for early flower initiation of *Ixora* hybrids (Vulcanus, Chanmai, Nora grant and Kontiki) at outdoor and shaded conditions, (2) the effect of light and shade on early flower initiation and (3) a method of synchronization of flowering within the same batch of plants.

2. Materials and Methods

2.1. Study Area

This study was carried out at the Serendib Horticulture Technologies (Pvt) Ltd., Sri Lanka, with four *Ixora* hybrids namely Chanmai, Vulcanus, Nora Grant and Kontiki.

2.2. Experimental

Cuttings of *Ixora* hybrids were planted on coir dust beds and kept in propagators for four weeks for rooting. Rooted cuttings were then planted in pots (12 cm diameter) kept in a net house and the basal fertilizer (Osmocotte 5 g/pot) was given. The potted plants were allowed to grow under shade net for 3-4 weeks. Pinching was practiced at 2-months age to induce more shooting and thereby a compact nature. An additional fertilizer (Crop Master) was applied once a week for all plants since root initiation till the end of the experiment. Plants to be treated in normal light condition were trained and acclimatized for two weeks while other plants were maintained under the net house itself (shaded with 50% shade net).

Sixteen treatments with controls were applied by combination of four concentrations of Hormone containing Nitrobenzene; H1- 0.075% (V/V), H2- 0.1%, H3- 0.125% & H4- 0.15%, two types of Fertilizer; F1- Bloom special & F2- Krista K 44 and two light conditions; L1- outdoor light & L2- net house shade. Each treatment consisted of three *Ixora* plants and had five replicates. The hormone was sprayed on foliage once in two weeks and both fertilizers were applied as a liquid spray once a week at the same concentration (1 g/L of water). Flower buds initiation was recorded for five weeks.

2.3. Statistical Analysis

The percentage of flower induced plants at 5-weeks of treatment was transformed into log values and then used for the analysis of variance.

3. Results and Discussion

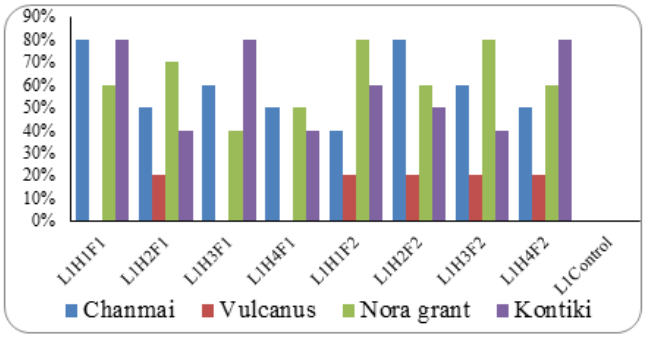

Figure 1. *Percentages of flower induced plants under each treatment for ixora hybrids at outdoor light condition*

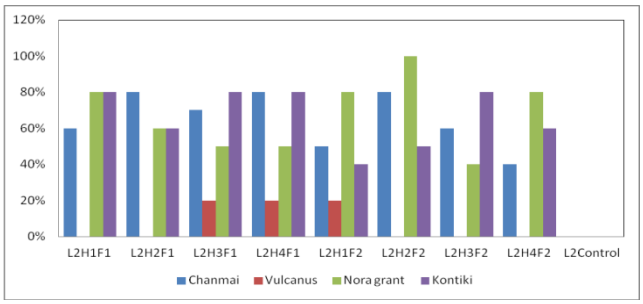

Figure 2. *Percentages of flower induced plants under each treatment for ixora hybrids at shade condition*

Figure 3. *Flower formation in Ixora coccinea hybrids. a: Chanmai; b: Vulcanus; c: Nora grant; d: Kontiki*

The results revealed that the plants in the control did not show any flower initiation at both light levels. However, all the treatment combinations showed more than 40% of flower initiation under both light conditions (Fig. 1 & 2) though the percentage of flower formation varied according to the variety (Fig. 3). The highest flower induction (100%) was observed in the hybrid Nora grant under shade condition (Fig. 2). The hybrid Vulcanus showed only 20% of flower initiation in few treatments while no flowers were observed in other treatments (Fig. 1 & 2).

Six month aged plants responded in flower initiation for growth regulator containing Nitrobenzene in combination with potassium supply by two fertilizers. The treatments significantly initiated flowers of all *ixora* hybrids except vulcanus compared to the control ($p > 0.05$). Hybrid Vulcanus was different in morphology with other three hybrids since it was a dwarf type chinese *ixora* hybrid. According to reference [8], the terminal bud of 6-month-old chinese *ixora* was in vegetative phase. Moreover, no significant difference was observed among four levels of the flowering hormone and between the two types of fertilizers ($p > 0.05$). In fact, least expensive combination (combination of least amounts of hormone and low cost fertilizer type) of hormone (containing Nitrobenzene) and the two types of fertilizers could play a profitable and a positive role in early flowering of *ixora hybrids* except vulcanus at six months age. Outdoor light condition and shade conditions were not significantly different showing the potential of early flower initiation of the hybrids even at shade condition with no effect by the sun loving character of *ixora* plants. However, as mentioned in reference [9] for Rosa hybrids Mercedes, the involvement of photoreceptor phytochrome for flowering response needs to be studied.

4. Conclusion

Least expensive combination of hormone and the two types of fertilizers could be successfully used for early flower initiation of six months aged *Ixora* hybrids except in Vulcanus either in light or shade conditions.

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