



Studies on the Upper Leaf Necrosis in Orientalliliums

S. Karthikeyan ^{a*}, S. P. Thamaraiselvi ^b, M. Ganga ^a,
M. Jawaharlal ^a, M. Visalakshi ^c and V. Sivakumar ^d

^a Department of Floriculture and Landscape Architecture, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

^b Horticultural Research Station, Tamil Nadu Agricultural University, Ooty, The Nilgiris, India.

^c Department of Medicinal and Aromatic Crops, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

^d Department of Fruit Science, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Oriental Lilium is one of the commercial bulbous flower crops grown for its cut flower and ornamental value. Upper leaf necrosis is a nutrition disorder that is specific to certain conditions and often misconceived with other disorders. The symptoms of upper leaf necrosis occur on the growing portions of the upper 3 to 5 pairs of young leaves in oriental lilium and it is more specific. The imbalance of calcium and boron nutrients which is actively involved in the growing regions of plants viz., root tip, bud development, and in the meristematic tissues resulting in deficiency causes upper leaf necrosis in the Oriental lilium. The research on supplementing the deficiency of nutrients through foliar application during the vegetative phase on critical days in oriental lilium variety Paradero helped in alleviating the necrosis symptoms. Treatments with foliar application of 0.08% &

*Corresponding author: E-mail: hortikarthik@gmail.com, hortikarthik@tnau.ac.in;

0.1% each of calcium nitrate & borax applied from 30 to 45 days after planting at 5 days intervals resulted in no visible necrosis symptoms (score 0), early appearance of flower bud (48 days) and a greater number of flower buds (3 - 4). Treatment with foliar application of 0.1% each of calcium nitrate & borax ensures a greater number of flower buds (4) per plant.

Keywords: Upper leaf necrosis (ULN); chlorosis; calcium; boron; leaf tip; oriental lilliums.

1. INTRODUCTION

Floriculture particularly cut flowers is an ever-shining and enterprising industry in terms of utility towards potential value for trade, business, and aesthetic sense. Lillium is a commercial cut flower bulbous crop truly representing purity as a symbol of love because of its flower value. The oriental lillium is now the fourth significant crop worldwide [1]. The flower crop is grown in the Nilgiris mountain range in the Western Ghats hill of Tamil Nadu, Southern part of India in an area of 40 ha under cool temperate environment. The geographical location of the crop cultivation lies in Kotagiri with Latitude: 11° 25' 48.00" N and longitude of 76°51'58.79"E. The climate prevailing in the range is best suited for the growing of bulbous lillium cut flower in greenhouse production system under naturally ventilated aerodynamic structures. Lillium bulbs are imported from the Netherlands to India through containers under -2°C temperature. The crop is preferred to grow mostly under soilless system of cultivation with coco peat as media.

The commercially cultivated types of lillium with Asiatic, Oriental, and Longiflorum x Asiatic types (LA) hybrid types are having demand in the international flower auction market. Oriental lillium types which has pink and white are the two major colors available fetching premium price. The total duration of the crop is 110 to 120 days. Lillium is a climate and nutrient sensitive crop which needs special attention throughout the cultivation of the crop. The upper leaf necrosis is a nutrient based crop regulation needs attention to remediating by supplementing with bulb treatment and foliar application of calcium and boron [2]. The prevalence of the upper leaf necrosis symptoms is more pronounced during the winter months of a year particularly from November to February. The requirement and demand of the flowers are more especially during the winter months of a year. The concept of high value low volume and high investment with intensive cultivation system makes crop cultivation grow more scientific and enterprising so that, the value of the business and utility is known to the flower grower.

The scientific profound of taking up the work from the inputs to increase the efficiency will helps to maximize the economy and value of the crop for horizontal expansion. With the background, the hypothesis was formulated to address the gaps in the requirement and supplementing the nutrients with bulbous treatment during the initial period and foliar formulations during the critical days of growth in a crop cycle which will certainly add a value and economic benefit to the crop.

2. MATERIALS AND METHODS

The research on the management of the upper leaf necrosis was carried out in the Horticultural Research Station, Ooty, The Nilgiris belonging to the Tamil Nadu Agricultural University, Tamil Nadu in India. The hill range is located in an altitude range of 1000 metres to 2600 metres above mean sea level. The work was taken up during the period of winter months from November to February in a year where the occurrence and chance of upper leaf necrosis will be more. The research was undertaken during the period of winter months from the year 2016 to 2018. The completely randomized design was employed for taking up the experiment with three replications and seven treatments. The Lillium bulbs imported from Netherlands which were kept under -2°C were subjected to calcium chloride @ 2.5 g per litre of water for 10 minutes and planting of bulbs were taken up subsequently following the cultural requirements for the management of the crop. The research was taken under pot culture by imposing the set of treatments with calcium nitrate and borax under different combinations of dosages as 0.05%, 0.1%, 0.15%, 0.2%, 0.25%, 0.3% and as control without application of foliar nutrients and bulb treatment. The foliar application was taken up and done with treatments between 25 to 45th day at 5 days intervals. The trial was carried out duly following the norms and procedures to be considered in layout and execution of a research trial under field conditions in greenhouses. The meteorological parameters on temperature, light intensity and relative humidity, vegetative

parameters namely plant height (cm), number of leaves and buds per plant, days taken for flower bud appearance, days to first harvest and the stage of appearance of upper leaf necrosis prevailing during the trial was recorded. The incidence of upper leaf necrosis and severity index was documented as per the symptoms prevailed and score value defined by Yao-Chien et al. [3]. The obtained data were subjected to statistical analysis as suggested by Panse and Sukhatme, [4].

List 1. List of symptoms

| Score | Symptoms |
|-------|-------------------------------------|
| 0 | No visible necrosis symptoms |
| 1 | Chlorotic spots |
| 2 | Curled leaf margin |
| 3 | Marginal necrosis |
| 4 | Dead leaf tip |
| 5 | >50 % of the leaf area was necrotic |

3. RESULTS AND DISCUSSION

Lilium cut flower production is more pronounced with the occurrence of more physiological symptoms and nutritional factors. The leaf tip burn, necrosis, scorch, leaf burn is the most commonly occurring symptoms related to lilioms. The symptoms of upper leaf necrosis occur on the growing portions of the young leaves in oriental lilium and it is more specific in the top three to five pair of leaves. Chang, 2002; Chang and Miller, 2003 reported that there is a very low bulb calcium content that cannot meet calcium demand when the upper leaves are expanding. The young expanding leaves of Lilium variety 'Star Gazer' are highly overlapped before flower buds are visible. This leaf 'enclosure' reduces transpiration of young leaves and encourages the development of Upper Leaf Necrosis. Calcium deficiency may result in problems such as upper leaf necrosis in the Lilium Oriental hybrid 'Star Gazer'. Choi et al. [5] reported that a good fertilizer accelerates calcium uptake and enhances the quality of both cut flowers and lily bulbs.

Tsai et al. [5] corroborated that both low transpiration rates due to overlapping young leaves and an unbalanced calcium distribution during the fast growth period caused Upper Leaf Necrosis in oriental lilies. Leaf enclosure further affected calcium transportation in young leaves and promoted Upper Leaf

Necrosis. Chang and Miller, 2003 thought that the lower and middle leaves relied more on calcium supplied from the bulb, while upper leaves and flowers relied more on calcium uptake from the roots, because roots were not enough strong and could not supply calcium for the upper leaves.

A survey on the occurrence of upper leaf necrosis has been done in six leading lilium growing units in Ooty and Kotagiri taluks of The Nilgiris district were done prior to taking up the experiments. The report clearly depicts upper leaf necrosis symptoms prevalence in most of the lilium flower growers and giving an economic loss for the growers. The survey taken up with the lilium growers have given a precise information about the prevalence of upper leaf necrosis and the necessity to take up the research which will help the growers find a solution for the problem. The loss out of the necrosis symptoms is that, the total value of the flower stem has got no value after it gets affected. The leaf and even flower buds in sometimes are getting affected by this occurrence of upper leaf necrosis. A similar group of survey on the trends in cut flower cultivation of lilioms and its status has been taken up in the South Korean flower industry by having the necrosis as one of the promising parameter for its correlation study [6].

In commercial cultivation of the lilium crop, the fertigation for lilium bulbs starts from 20 days after planting. Bulbs serve as a storage house for the supply of nutrients during the first 20 days of crop growth. The water-soluble fertilizers were given daily to the crop in soilless (Cocopeat) medium of cultivation. The upper leaf necrosis symptoms express during the 30 to 45 days of crop growth. Cocopeat acts as a medium for the growth of plants and the additional supply of nutrients has to be met through foliar application. This will help in reducing the occurrence of upper leaf necrosis symptoms. The typical symptom of upper leaf necrosis occurring in the oriental lilioms is similar to those symptoms occurring in other crops caused by calcium deficiency. Similar type of necrosis has been identified and reported by Yao-Chien Chang, [3] in oriental lilioms. The observations on vegetative and flowering phase on critical days were recorded for the occurrence of upper leaf necrosis. Treatments T₄ & T₅ expressed better response for foliar application of 0.08% & 0.1% each of calcium nitrate & borax applied during 30 to 45 days after planting at 5 days interval which resulted in no visible necrosis

symptoms (score 0), early appearance of flower bud (48days) and a greater number of flower buds (4). The treatment T₅ expressed better response for foliar application of 0.1%

each of calcium nitrate & borax applied during 30 to 45 days after planting at 5 days interval for upper leaf necrosis and flowering parameters.

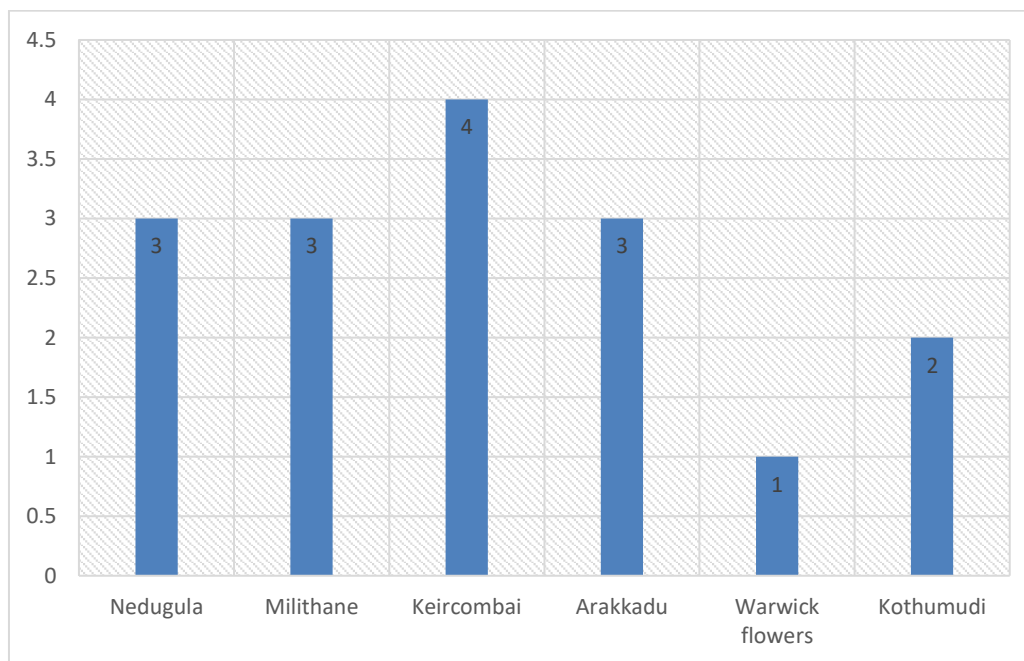


Fig. 1. Survey on Incidence of ULN Score among leading flower growers

Table 1. Effect of calcium and boron on upper leaf necrosis appearance on vegetative & yield parameters in oriental liliums

| Treatment | Plant height (cm) | Number of leaves per plant | Days taken for flower bud appearance | Number of flower buds per plant |
|----------------|-------------------|----------------------------|--------------------------------------|---------------------------------|
| T ₁ | 80.50 | 36.00 | 64.00 | 3.00 |
| T ₂ | 82.80 | 39.50 | 64.00 | 4.00 |
| T ₃ | 85.00 | 40.50 | 60.00 | 3.00 |
| T ₄ | 86.50 | 42.00 | 52.00 | 3.00 |
| T ₅ | 83.00 | 38.00 | 48.00 | 4.00 |
| T ₆ | 95.00 | 44.00 | 64.00 | 3.00 |
| T ₇ | 78.00 | 34.00 | 60.00 | 2.0 |
| Mean | 84.40 | 39.14 | 58.86 | 3.14 |
| SE(d) | 0.32 | 0.25 | 0.48 | 0.05 |
| CD (0.05) | 0.75 | 0.47 | 0.89 | 0.09 |

***90 days after planting**

Treatment details

- T₁: Foliar application - 0.02% each of CaNO₃ + Borax
- T₂: Foliar application - 0.04 % each of CaNO₃ + Borax
- T₃:Foliar application - 0.04 % each of CaNO₃ + Borax
- T₄: Foliar application - 0.08 % each of CaNO₃ + Borax
- T₅: Foliar application - 0.1 % each of CaNO₃ + Borax
- T₆:Foliar application - 0.15 % each of CaNO₃ + Borax
- T₇:Control (without foliar application)

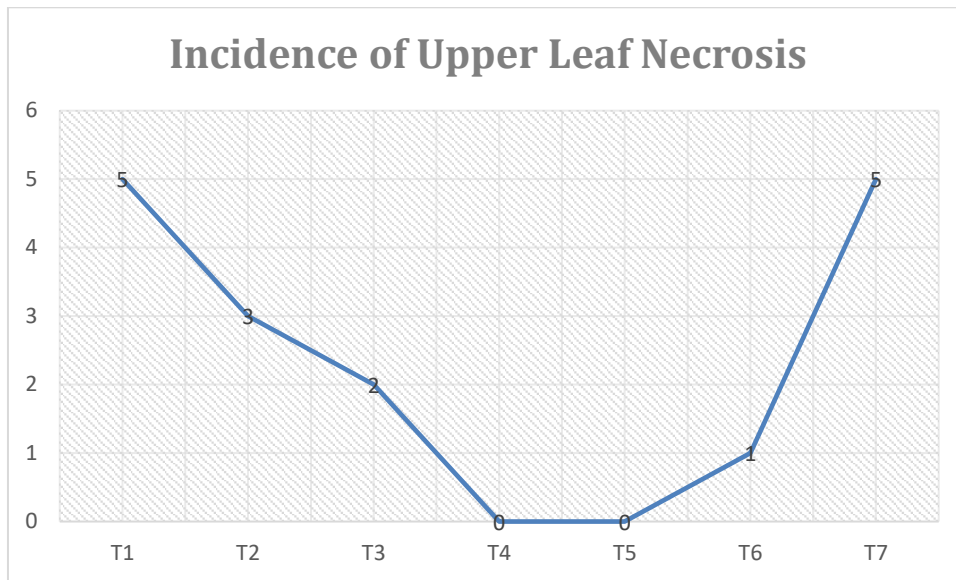


Fig. 2. Incidence of upper leaf necrosis appearance in oriental liliium



Plate 1. Severely affected symptom of Upper leaf necrosis in Oriental liliium variety 'Paradero'

The occurrence of the symptoms of the necrosis are particularly during the less evaporation days coupled with fewer light or low duration of light and when the transpiration/evaporation of the plants is lesser when compared with high-intensity of light ranges. Cocopeat acts as a medium for the growth of plants and the additional supply of nutrients has to be met through foliar application. This will help in reducing the occurrence of upper leaf necrosis symptoms. Foliar application of 1 gram per litre of calcium nitrate and borax applied during 30 to 45 days after planting at 5 days interval help in reducing the incidence of upper leaf necrosis in oriental liliiums. The management of proper ventilation system inside the greenhouses by

temperature and humidity in the day time during the winter months will help in the evapo-transpiration and uptake of nutrients. Similar result was also reported by Wu et al. [7] in *Ornithogalum dubium* [8-11].

4. CONCLUSION

The study on upper leaf necrosis in oriental liliium which is correlated with calcium and boron requirements is an important and critical area where the quality and further development stages of crop is determined. In this connection, the study taken with a survey on the liliium flower growers and its occurrence during the winter months is done and the problems are addressed

with an supplemental foliar application which favours for the growth of the crop. Foliar application of 1 gram per litre of calcium nitrate and borax applied during 30 to 45 days after planting at 5 days interval helps in reducing the incidence of upper leaf necrosis in oriental liliiums. Bulb dipping with calcium chloride @ 2.5 g/litre of water for 10 minutes duration before planting is to be done. The management of proper ventilation system inside the greenhouses by temperature and humidity in the day time during the winter months will help in the evapo-transpiration and uptake of nutrients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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