Excerpts from

Security Lighting and Its Impact on the Landscape

by H.M. Cathey and L.E. Campbell

This article appeared in the Journal of Arboriculture in 1975. Coming across it 25+ years later, one may be slightly jolted to be taken back to a time when high-pressure sodium lighting was a relatively new thing. And the term "security lighting," used here to encompass street lighting, has perhaps a more narrow meaning today. Nevertheless, these excerpts provide valuable basic understanding of the impact of dusk-to-dawn lighting on landscape plants.

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Recent programs of installing security lighting in our urban areas may have a major impact on mankind and on all the other organisms that share the landscape. Artificial lights have been designed for one primary function--to give mankind visibility in the dark. Good visibility is a basic requisite for public safety; it also permits prolonged periods of activity during each day. Although the motivation for the installation of artificial light has always been the comfort and security of mankind, the same sources of illumination can alter the activity of all organisms on the landscape. We have only to step outside on a summer night and view the extensive collection of night-flying insects that have been attracted by the porch lights. The same light--with a yellow coating--becomes a bug lamp. Bug lamps emit much less blue light and thus are much less attractive than ordinary lights. These same lamps have also been the basis for the technology that permits ornamental plant growers to shift and regulate the growth and flowering times of many kinds of plants.

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About 1965, the introduction of high-pressure sodium (HPS) lamps gave street lighting a yellow-colored lamp with approximately double the efficiency of mercury lamps. These lamps emit less blue light with more yellow and red light.

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Day-length effect on plants has been identified for more than 50 years as the major signal from the environment that regulates plant response. From these observations, we now know that light-dark cycles during the 24-hour day trigger the flowering, branching, dormancy, bulbing, and many other growth responses of plants.

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Light throughout the 24-hour day inhibits flowering and promotes vegetative growth of short-day plants, encourages continued vegetative growth and early flowering of long-day plants, and increases stem lengths of day-neutral plants. Plants vary greatly in their responsiveness to light source, duration, and intensity. Since the new light source, HPS, provides illumination from dusk to dawn at intensities seldom before used for street lighting, many questions have been received from florists and nurserymen concerning what effect these lights would have on their fields and greenhouses adjacent to the brightly lighted areas. Poinsettia, chrysanthemum, and orchid growers learned the first year that their plants had to be covered nightly in order to avoid altering their scheduling of flowering. Into the fall season young plane trees (sycamores) in the nursery grew more rapidly and much later than plants of similar age that had been screened from the night lighting. Winter dieback was severe on the lighted trees during the following spring.

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Based on this abstract and subsequent interviews, we have received numerous requests to clarify the impact of the new street lighting technology on plants in the landscape.

Q. Is there a combination of factors involved, all of which must be eliminated, or is there a single key factor at the root of the problem?

Light exerts its growth-controlling effects only when the environmental and cultural conditions are properly combined to permit rapid growth. Any factor that would limit growth--cold, heat, drought, standing water--could override the effects of the security lighting. Light alone, at the intensities used for street lighting, is insufficient to sustain growth. Its effects come into force only when the natural day is adequate to permit growth. Thus, night temperatures below 55E or above 90EF limit the effectiveness of the night lighting. Periods of extra dry or wet weather would limit growth and thus reduce the sensitivity of the plants to the night lighting.

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Q. *Do mercury vapor and metal halide lamps cause the same response in plants as does the high-pressure sodium lamp?*

All lighting that produces long-day effect on plants exerts the same growth control of promoting the formation of new leaves and the elongation of the distances between the leaves. Mercury vapor and metal halide lamps emit so little red light that they delay flowering only on a greenhouse crop such as poinsettia and promote continuous vegetative growth only on highly responsive trees such as birch, elm, and sycamore. Only 7 of the 22 species tested exhibited any growth responses to the mercury vapor and metal halide lamps. However, HPS lamps altered the growth responses of 16 of the 22 species tested, only one less than the number of plant species that were responsive to night lighting with incandescent-filament lamps.

Q. We would like to know whether the increased plant growth is due to light quality or intensity or to a combination of both?

The increased growth is in response to a combination of light quality, intensity, and duration interacting with the environment. The significant change from the older street lighting systems to the HPS lamps is the change in the intensity of lighting at street level and plant height. It is probably two to four times higher than was formerly used, as measured on a footcandle scale.

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Q. What could be the side effects on the plants exposed to security lighting?

Nighttime lighting has one primary effect, to promote continuous growth or elongation of plants when the natural environment is signaling a stopping of growth. This is the major concern, that lighting could alter the way that plants receive their signals from the environment and how they adjust their growth characteristics according to the season. If growth continues, the plants may still be growing when the first killing frosts of fall come. This would mean increased winter injury to plants during the following spring. It would be obvious during the spring when the tips of the limbs of the plants nearest the lamps would not leaf. Only one side of the plant or part of a limb may be affected by the light. Photoregulation because of artificial light is not translocated from one limb of the plant to another. One can observe directly the effects of the lighting in relation to the distance of the plant to the light and the effects of the position of the various limbs of the plant to the light source.

Q. Are trees affected because of the continuation of a minimum level of light, daylight and artificial, on a 24-hour basis with no opportunity to rest?

Growth responses that are due to photoperiod have no relationship to the concept of rest. This is a concept that mankind brings from its own way of living to the plant world. Plants live out-of-doors throughout 12 months and adjust their growth patterns in response to the light-dark signal from the environment. Their actions are modified by temperature, carbon dioxide, nutrition, water, and many other factors. Continuous lighting depresses the formation and maintenance of chlorophyll in leaves and promotes lengthening of the internodes of the branches and expansion of leaf area. All of these changes increase the likelihood that the leaves will be more sensitive to air pollution during the growing season. Most daily newspapers report the concentration of oxidants in the atmosphere based on the standards of measurement established by the Council of Government's Air Quality Index. Air pollution alerts are called when the level of oxidants in the atmosphere exceeds 100 parts per 100 million (by definition). Plants in a state of more rapid growth face a greater risk of being injured by the increasing levels and frequencies of air pollution than plants growing without security lighting. One can detect air pollution injury on the recently matured leaves, as they will initially have a glistening, oil appearance. The tissues between the veins of the leaves may turn pale green or white. The margins of some leaves may dry to tan and may eventually rupture. The oldest leaves may progressively die and drop from the plants.

Sources of Additional Information

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Plant Genetics and Germplasm Institute, and Agricultural Environmental Quality Institute, ARS-USDA, Beltsville, Maryland.