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GROWTH REGULATORY EFFECTS OF IAT SOIL TREAT ON SOYBEAN (*GLYCINE MAX MERR.*) VAR: TGX 536 – 02D

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ABSTRACT

The effect of IAT soil treat on germinated seedlings of soybean was observed. The germinated seedlings were treated with the chemical after 14 days using the soil drench method. The chemical in concentrations of 20 ppm and 30 ppm were used, and tap water was used for the control. The results showed that stem height, fresh and dry weights of stem did increase significantly, and not much was noted in the root length. The chemical significantly increased the chlorophyll and total soluble carbohydrate contents while that of the carotenoid was not significant, although the chemically treated plants maintained higher levels than the control. Finally, the 30 ppm treated plants yielded more than the 20 ppm as well as 0 ppm.

Key words: IAT Soil treat, Phytochromone.

INTRODUCTION

The growth and development of the plant is controlled and integrated by phytochromones. For example, the growth of the root, leaf, stem, fruit and other organs is controlled by phytochromones. Phytochromones have two sources, those are produced by plants, are referred to as endogenous phytochromones, example, auxin, gibberellins and cytokinin. Those which are not produced by plants are referred to as exogenous phytochromones; these are the synthetic phytochromones. Examples of synthetic phytochromones are Cultar, Triadimefon, AMO – 1618, α – naphthalene acetic acid (2,4 – D), 2,4,5-trichlorophenoxy acetic acid (2,4,5-T), Cycocel (CCC), 6-Benzyl amine purine (BAP) and "IAT Soil Treat", which are oxogenously applied, are used to direct morphogenesis in tissue and organs to achieve a particular objective.

As stated by Martin[1], phytochromones play significant role in promoting and inhibiting plant growth. As a growth inhibitor, cultar controls growth activity in a variety of

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agronomic and horticultural species, and its mode of action is to act as anti-gibberellin, and most of its action can be counter-balanced by gibberellins application as soil drench. The chemical has the capacity of protecting plant species from environmental stress like pollution, heat and chilling.

Another important phytochormone is Triadimefon, a derivative of triazole, which is a fungicide and acts as a phytochormone. It has been found that it can change the growth of higher plants by blocking gibberellins biosynthesis by interfering with oxidative dimethylation reactions, and in fungi, it blocks ergostrol biosynthesis[2]. The chemical reduces stem height and leaf area in *Phaseolus vulgaris*. Plant species treated with triadimefon resulted in the development of roots, thickens and greens leaves, reduced leaf enlargement and prevent flowering[3]. Triadimefon has been much useful in increasing plant species resistance to environmental conditions such as salt concentrations, chilling and pH changes in the soil[4].

AMO-1618, block the synthesis of gibberellins acid; hence, inhibiting stem growth. Many of the hormones, such as IBA, IAA, 2,4-D and 2,4,5-T are in most cases used as herbicides. For example, 2,4-D is used as a herb-killer, especially on bread-leaved dicot species[5]. With the exception of 2,4-D, the rest are used in potato storage to inhibit lateral bud sprouting and in sprays for fruit trees to prevent premature fruit drop[6].

A growth retardant, CCC is known to inhibit the synthesis of chlorophyll in leaves of potatoes during the early period of development and delay the degradation of chlorophyll during the latter stage[7].

The plethora of phytochromones given above have played diverse roles in plant growth, but with increasing population, there is the need for a corresponding food production increase, in order to avoid the hazards of starvation. One of such solutions is the development of new agrochemicals to boost plant growth and improve yield of crops. “Integrated Agricultural Technology Soil Treat, (IAT Soil Treat)” is among the newly agrochemical being synthesized to boost food production.

As a biostimulant, IAT Soil Treat is made up of growth regulator, enzymes and micro-nutrients, which has the ability of accelerating growth and increase yield. It is made up of cytokinin (as Kinetin) 0.01% based on biological activity and 99.99% inert ingradients (IAT Soil Treat bulletin 1986)[8].

Unlike foliar applied phytochromones, IAT Soil Treat application is by soil drenching, band spraying and broadcasting through irrigation. The chemical helps to improve the efficiency of fertilizers by converting insoluble fertilizers into soluble nutrients. Again, it is also helpful in the rapid decomposition of organic matter and improves the retention of water as well as aeration, and the formation of soil tilth[8].

Not much is known about most of these synthetic phytochromones, especially IAT Soil Treat in the West African Sub-Region. This calls for much research work into its activity and therefore, this work has been carried out to find out its effect on the vegetative growth, levels of photosynthetic pigments, soluble carbohydrates and yield of soybean (*Glycine max merr* Var.: TGx 536 – 02D).

EXPERIMENTAL

Materials and methods

Sowing of seeds

Sowing was done in black polythene bags of size 16 x 12 cm and black buckets of volume 11 litres, having their bottoms perforated and filled with sandy loamy soil to about ¾ of their volumes. After germination, thinning of the seedlings was done leaving one in each bag or bucket.

Treatment of seedlings

Two weeks after germination, the seedlings were treated with 200 cm^3 of IAT Soil Treat at concentrations of 20 ppm, 30 ppm and tap water as the control. Soil drenching was the method of application. There were six replicates per treatment for yield studies. Seedlings in the polythene bags were used for the growth analysis and physiological studies. After application of the chemical, the seedlings were not watered for three days and there after watering were resumed.

Growth measurement

Fresh and dry weights determination

Harvesting was done four times, at two weeks intervals. Five seedlings per treatment were uprooted, after initial watering of the soil. After careful removal of the plants, they were washed and blotted. The seedlings were divided into root and shoot, and their fresh weights were taken using Metler AE 60 balance. They were then placed in the oven set at 80^0C for 24 hours and their respective dry weights taken after cooling.

Height measurement

Five seedlings per treatment were randomly selected, and measured using a meter rule for a period of 56 days at 14 days interval. Measurements were taken from the top of the soil to the terminal bud and from the level of the stem marking the ground level to the tip of the tap root, for the stem and root, respectively.

Photosynthetic pigment determination

Chlorophyll and carotenoid are photosynthetic pigments, their contents were determined using the fifth leaf of each treatment. Four replicates per each treatment were used. The pigments were extracted by the method described by Witham et al.[9]. Absorbance was read on the B-L Spectrophotometer 20, with the wavelength set at 663, 645 and 480nm.

The amount of photosynthetic pigments present in the leaf extract was calculated using the formula given by Witham et al.[9]

Determination of amount of total soluble carbohydrate

The determination of total soluble carbohydrate in the fifth leaf of the seedling was performed using Anthrone reagent and spectrophotometry as described by Witham et al.[9]

Yield studies

Dry pods per plant were harvested and labeled. Pods per plant were counted and weighed. Again, the seeds per plant were also weighed.

RESULTS AND DISCUSSION

IAT Soil Treat significantly increased the vegetative growth in soybeans. Both concentrations of the chemical significantly increased stem height compared to the control (Fig. 1a). From the 42nd day to the end of the experimental period, both concentrations of the chemical increased the stem height to a greater extent than the previous weeks.

The concentration of IAT Soil Treat applied, slightly increased the root length of soybeans, with exception of the 56th day, where there was significant increase in length of the roots in the treated plants (Fig. 1b).

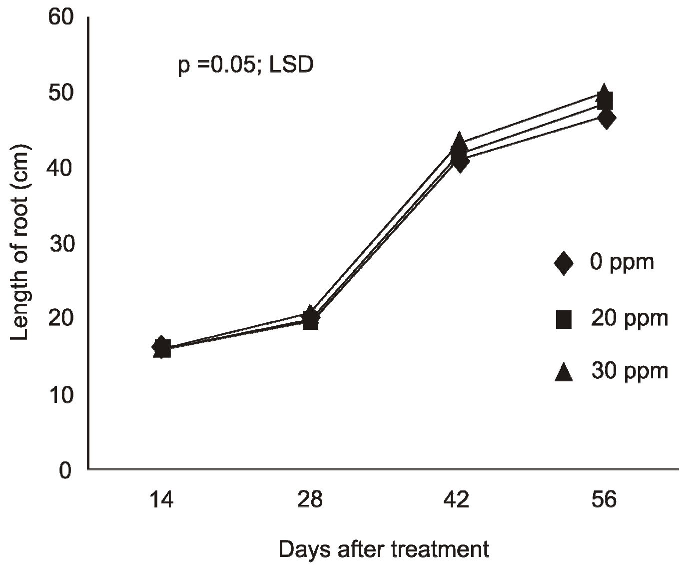

Figure 1a: The effects of 0 ppm, 20 ppm and 30 ppm (IAT Soil Treat on root of soybeans)

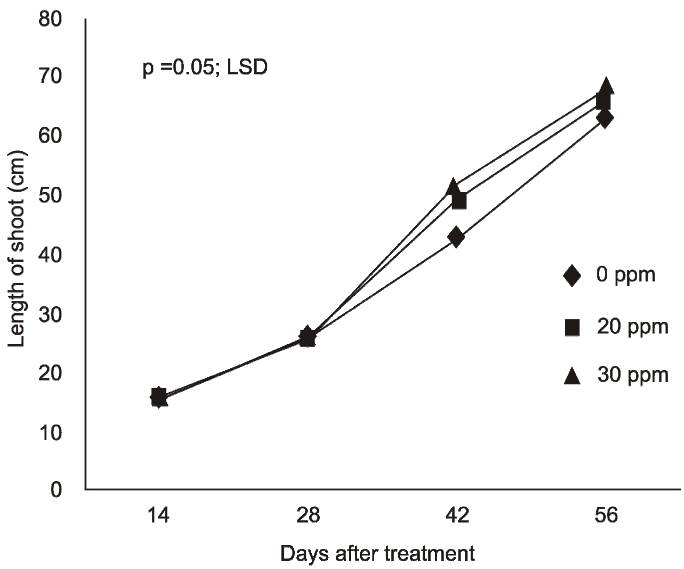

Figure 1b: The effects of 0 ppm, 20 ppm and 30 ppm (IAT Soil Treat on shoot of soybeans

The soybean-treated plants showed significant increased in fresh-weight of the root (Fig.

2a). Both concentrations of the chemical significantly increased fresh weight of shoot from the 28[th] day to the end of experimental period (Fig. 2b).

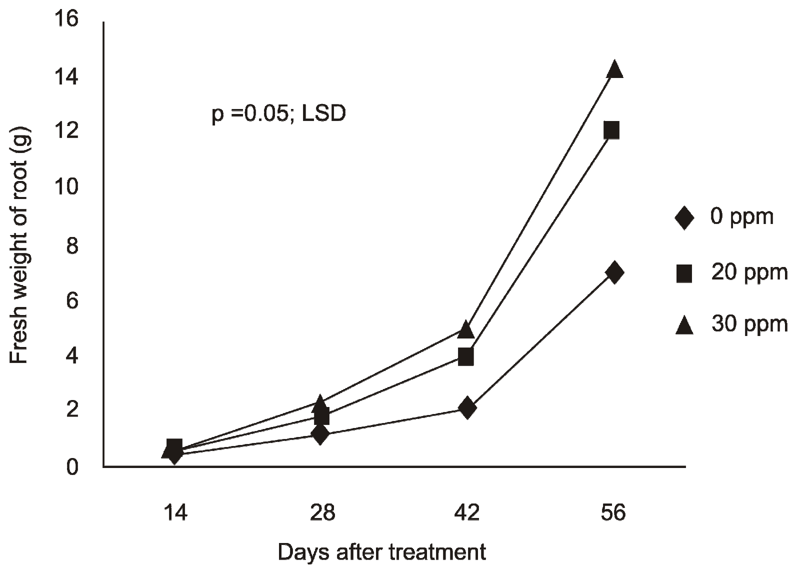

Figure 2a : The effects of 0 ppm, 20 ppm and 30 ppm (IAT Soil Treat on fresh weight of root of soybeans)

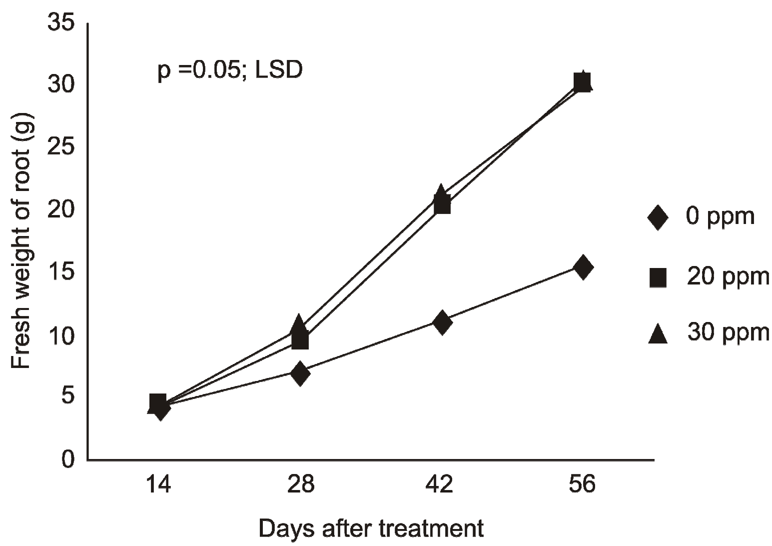

Figure 2b: The effects of 0 ppm, 20 ppm and 30 ppm (IAT Soil Treat on fresh weight of shoot of soybeans)

As expected, the chemical significantly increased the dry weight of root as compared to the control (Fig. 3a).

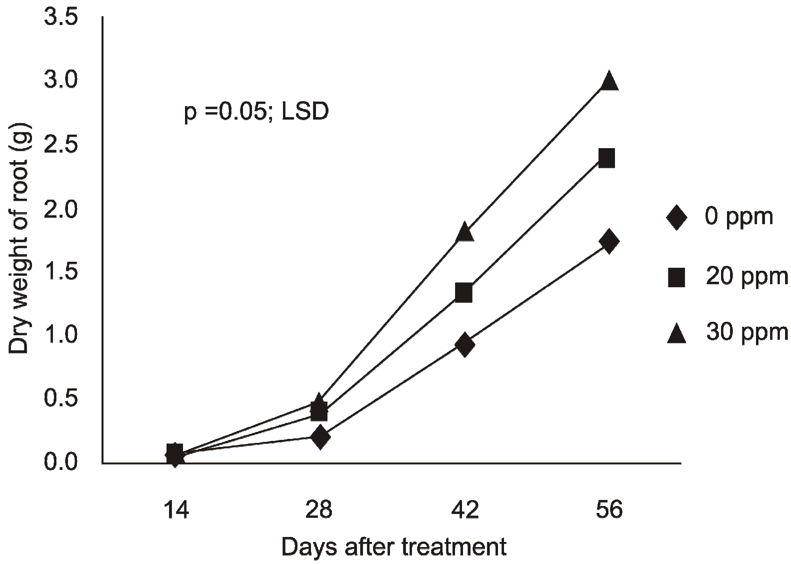

Figure 3a: The effects of IAT soil treat on dry weight of root of soybeans

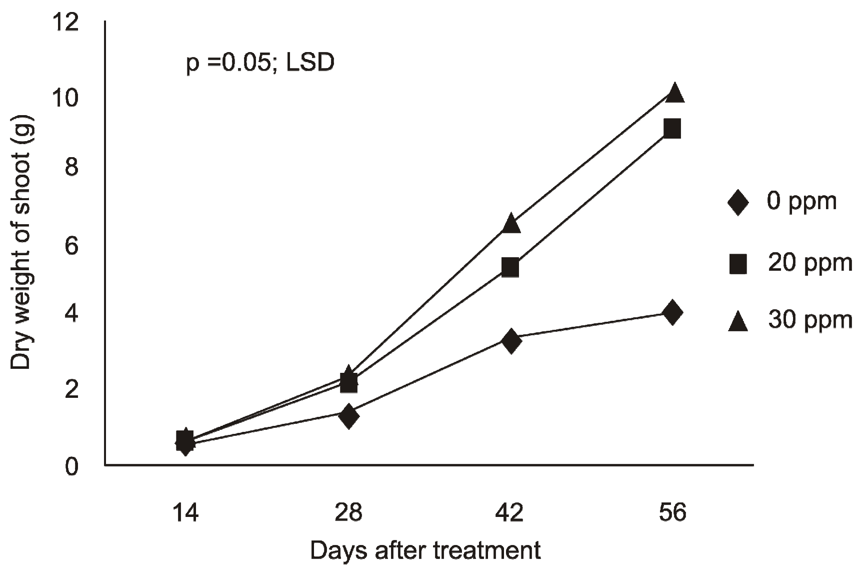

Figure 3b: The effects of IAT Soil Treat on dry weight of shoot of soybeans

There was significant increased in the dry weight of the shoot more than the control (Fig.

3b).

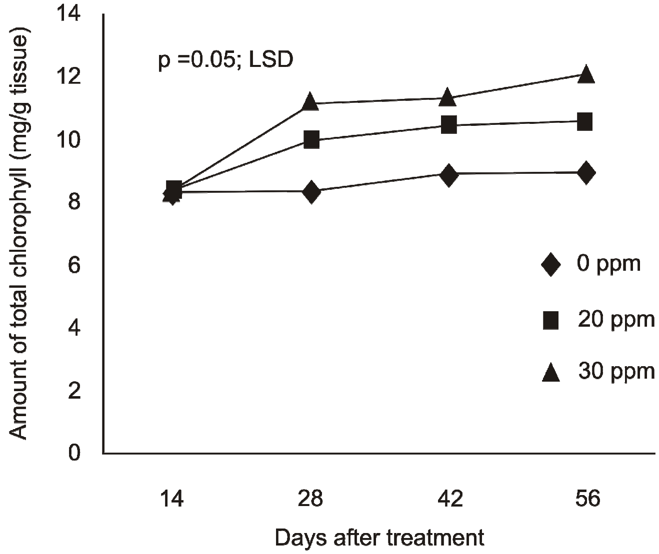

Figure 4a: The effects of IAT Soil Treat on chlorophyll content in the 5th leaf of soybeans

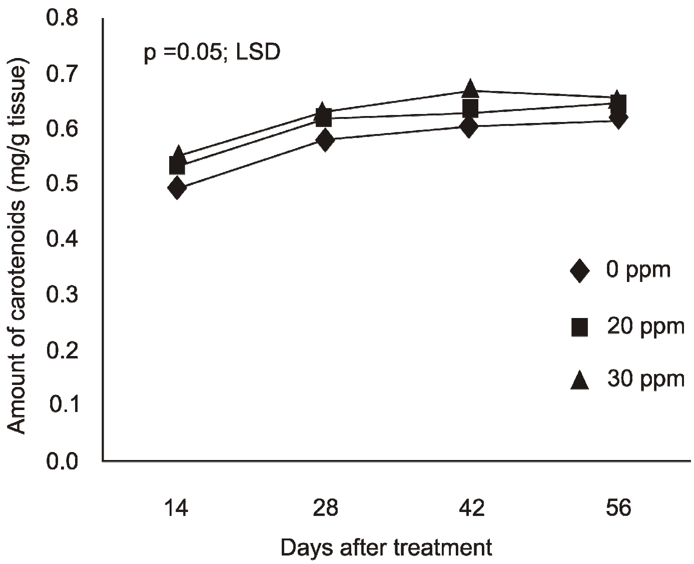

Figure 4b: The effects of IAT soil treat on the total carotenoid content in the 5th leaf of soybeans

IAT Soil Treat increased the photosynthetic pigments, chlorophyll and carotenoid contents. From the 28th day after treatment to the end of the experimental period, the two concentrations of the chemical significantly increased chlorophyll content in the leaves of soybeans as compared to the control (Fig. 4a). IAT Soil Treat-treated soybean plants maintained higher carotenoid contents as compared to the control (Fig. 4b).

The chemical significantly increased the total soluble carbohydrate content. Comparatively, the Soil Treat-Treated plants maintained higher total soluble carbohydrate levels as compared to the control (Fig. 5).

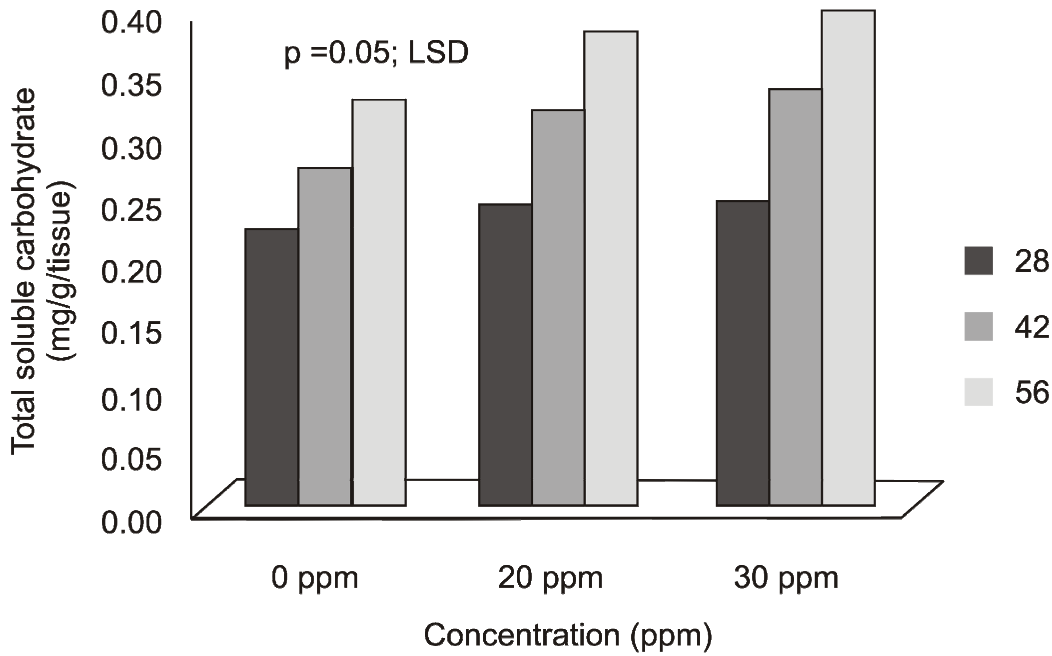

Figure 5: The effects of IAT soil treat on the total soluble carbohydrate content in the 5th leaf of soybean

Soil Treat significantly increased the yield of soybeans (Table 1). The weight of seeds per plant, weight of pods and seeds per plant, and number of pods per plant of the Soil-Treat treated plants exceeded that of the control, with the 30 ppm treated plants yielding more than the 20 ppm treated plants.

The investigation shows that IAT Soil Treat enhanced vegetative growth as well as yield. IAT Soil Treat increased the stem height, fresh and dry weights of stem as well as the root length of soybeans. The results are similar to those reported earlier in other plant species, like potatoes, tomatoes, apple, citrus and corn (IAT Soil Treat Bulletin 1986)[9]. These responses might have resulted from the cytokinin component, which stimulates cell division and expansion. Plant species treated with cytokinin caused radial enlargement of cells[10].

Table 1: The effects IAT soil treat on the yield of soybean

Treatment concentration	Weight of pods + seeds/plant (g)	Weight of seeds/plant (g)	Number of pods/plant (g)
0.0 ppm	5.5[a]	2.9[d]	33.0[a]
20.0 ppm	6.7[b]	3.6[b]	48.0[b]
30.0 ppm	8.9[c]	4.8[c]	53.0[c]

Means in a column followed by different letters are significantly different at $p \leq 0.05$, according to Duncan's Multiple Range Test.

The IAT Soil Treat increased the total chlorophyll and carotenoid levels in soybean plant (IAT Soil Treat Bulletin 1986). It must be noted that the addition of cytokinin promotes stroma lamellae formation but not the formation of chlorophyll and grana[11]. However, in the presence of light, cytokinin produces stroma lamellae, grana and chlorophyll. Development of stroma lamellae as well as grana and chlorophyll formation is minimal if no cytokinin is added to light grown callus[11]. This information proves that the presence of cytokinin in leaves is important for chloroplast development. In soybean leaves, IAT Soil Treat increased total soluble carbohydrate content. This might has resulted from cytokinin, which enhances photosynthesis in apple leaves[12]. Due to IAT Soil Treat's ability to increased chlorophyll content, it may have enhanced photosynthetic activity which brought about increase in the carbohydrate content in the leaves.

IAT Soil Treat increased yield in soybean may be due to the ability of IAT Soil Treat to enhance chlorophyll activity, photosynthetic activity and its capacity to regulate enzymes in the plant system making nutrients in the soil available to the plant (IAT Soil Treat Bulletin 1986).

In this research, IAT Soil Treat increased root length, and it substantiates some of the effectiveness of IAT Soil Treat as a phytochrmone.

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