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Effect of different nutrient formulations on growth and yield of *Cordyline fruticosa* grown in soilless culture system

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Abstract

Cut foliages are an important component of the floricultural industry, largely used in decoration as filler in floral compositions. They provide freshness, colour and variety to arrangements and bouquets. *Cordyline fruticosa* is an important cut green in the world trade and used worldwide for its beautiful foliage. The increasing demand for the production of quality cut foliages pressurizes the flower growers to adopt advanced technologies even under poor resource conditions. Soilless culture is one such production system that involves precise control of nutrition and efficient use of water, which in turn resulted in quality produce commanding premium price in the market. Owing to the above demand, the present investigation was carried out during 2017-18 at Horticultural College and Research Institute, Periyakulam to determine the effect of different nutrient formulations on growth and yield of *Cordyline fruticosa* grown in soilless culture system. Eight nutrient formulations were tested for its efficacy along with rain water as control and observations on growth and yield parameters were recorded. The results of the study revealed that Hoagland and Arnon- nutrient formulation increased growth and yield parameters of *Cordyline fruticosa* grown in soilless culture system.

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Introduction

The floriculture industry involves the production and distribution of loose flowers, cut flowers and foliage, and ornamental plants to meet out the demand of the domestic and international market. Cut foliage is vegetation

used in large quantities as a source of decoration on its own or in association with flowers in bouquets. *Cordyline* belongs to the family Asparagaceae and commonly called as luck plant or cabbage palm is a tropical ornamental with high decorative value due to

its variety of colors and foliar patterns. The increasing demand for the production of quality cut foliage pressurizes the flower growers to adopt advanced technologies even under poor resource conditions. Hydroponics is the fastest growing sector of agriculture/horticulture, and it could very well dominate crop production in the future. Soilless culture can provide important requirements for plant growth with equal growth and yield results compared to soil. Nutrients play a very important role in obtaining quality foliage/flowers. The soil less culture involves precise control of nutrition and efficient use of water, which in turn results in quality produce commanding premium price in the market. Keeping this in view, the present investigation was carried out to determine the effect of different nutrient formulations on growth, yield and postharvest quality of *Cordyline fruticosa* grown in soilless culture system.

Materials and Methods

In this study, three months old plants of *Cordyline fruticosa* were planted in a plastic container containing different nutrient formulations. An open soilless culture system, which was irrigated and nourished by drip irrigation system, was used. The study was carried out during 2017-18 at Horticultural College and Research Institute, Periyakulam in Completely Randomized Block Design with nine treatments and three replications. The treatment consists of eight nutrient formulations according to cited works (Hoagland & Arnon 1950; Hewitt 1966; Colakoglu-1 and 2 2005; Steiner 1984; Bollard 1966; Middleton & Toxopeus 1966) and water

soluble fertilizer (19:19:19) along with rain water as control. The pH of the irrigation water was measured and set between 5.5 and 6.5 in all treatments (Ozzambak & Zeybekoglu 2004). Similarly, the EC of nutrient formulations was maintained between 1.5 to 2.5 dSm⁻¹ (Sonneveld & Voogt 1983) throughout the experiment.

Observations on morphological, physiological and yield parameters such as plant height (cm), number of leaves, leaf area (cm²), leaf longevity (days), Chlorophyll (mg/g), anthocyanin (mg/g) and yield were observed at 90 days after planting. The recorded data was subjected to statistical analysis (Panse 1954).

Results and Discussion

Effect of different nutrient formulations on morphological parameters

The production of quality foliage plants in soilless culture can be attained by the use of proper nutrient formulations, which have a prominent effect on growth. In the present study among the different nutrient formulations tested, Hoagland and Arnon-nutrient formulation (T₂) recorded significantly the highest plant height (52.46 cm), number of leaves (12.33), leaf area (207.16 cm²), leaf longevity (28.50 days) and leaf production interval (9 days) in *Cordyline fruticosa* at 90 days after planting, while the lowest plant height (52.46 cm), number of leaves (8.47), leaf area (145.97 cm²), leaf longevity (21.50 days) and leaf production interval (14 days) was recorded in T₁(control) (Table.1). The healthy and robust vegetative frame is an essential pre-requisite for high

vegetative growth. Major food manufacturing units in plants are leaves and the growth of them is chiefly influenced by given plant nutrient status. The increased vegetative growth in the Hoagland and Arnon- nutrient formulation may be due to the balanced availability and release of essential nutrients which enhances the uptake of nutrients, increase the assimilation capacity and ultimately the crop growth. The absorbed nitrogen ultimately lead to the formation of complex nitrogenous substances such as proteins/ amino acids to build up new tissues and thereby nitrogen greatly influenced the leaf growth, leaf area and photosynthetic rate. Longevity of leaves in a plant depends on the environmental conditions, nutrient status of

the plants and genetic factors. Calcium is responsible for holding together the cell walls of plants activating certain enzymes and to send signals that coordinate certain cellular activities that produce quality leaves with maximum longevity on plant. The promotive effect of Hoagland and Arnon- nutrient formulation on morphological characters are in accordance with the findings of Kilinc et al. (2007) in fig saplings; A (2012) in *Beta vulgaris*; Li & Cheng (2014) in cucumber seedling; Mohidin et al. (2015) in oil palm seedling; Azeezahmed et al. (2016) in chrysanthemum grown under soilless culture system; Sabareeswaran et al. (2018) in plantlets of *Dendrobium* var. Thongchai Gold.

Table 1. Effect of different nutrient formulations on growth of *Cordyline fruticosa* grown in soilless culture system

S. No	Treatment	Plant height (cm)	No. of leaves per plant	Leaf area (cm ²)	Leaf longevity (days)	Leaf production interval (days)
1.	T ₁	38.77	8.47	145.97	21.50	14.00
2.	T ₂	52.46	12.33	207.16	28.50	9.00
3.	T ₃	51.26	10.00	192.73	25.00	9.20
4.	T ₄	42.15	8.67	148.60	22.60	12.40
5.	T ₅	49.50	9.33	190.27	24.00	10.20
6.	T ₆	48.56	9.60	178.25	23.20	11.60
7.	T ₇	46.28	8.73	163.21	23.00	11.80
8.	T ₈	51.26	10.67	189.64	26.20	9.40
9.	T ₉	49.60	10.40	183.28	24.30	9.20
	Mean	47.76	9.80	177.68	24.26	10.80
	SEd	1.026	0.625	3.259	0.576	0.178
	CD (0.05)	2.152	1.319	6.833	1.201	0.381

Effect of different nutrient formulations on physiological parameters

In the present study among the different nutrient formulations tested, Hoagland and Arnon- nutrient formulation (T₂) recorded significantly the highest

chlorophyll content (1.64 mg/g), soluble protein (72.35 mg/g) and anthocyanin content (12.8 mg/g) in *Cordyline fruticosa* at 90 days after planting, while the lowest chlorophyll content (1.12 mg/g), soluble protein (62.83 mg/g) and anthocyanin content (8.14 mg/g) was recorded in T₁ (control) (Table.2).

Chlorophyll is the main pigment that takes part in photosynthesis, which is an essential process of plant system and also its growth and development. The increased accumulation of nutrients especially N, Mg, K can result in increased pigment synthesis or low rate of degradation of chlorophyll content. This also have a beneficial effect on phloem loading and probably also on the mobilization of photosynthates deposited in the leaves. The highest soluble protein content of cordyline plants grown in Hoagland and Arnon- nutrient formulation (T₂) may be due to the enhancement of photosynthetic pigment and the assimilates produced by the pigment. Anthocyanin is one of the most conspicuous

classes of flavonoids together with proanthocyanidins and flavonols are important plant pigments responsible for the red, pink, purple and blue colours in plants (Grotewold 2004). It can protect chloroplasts from the adverse effects of excess light causing photo-oxidative damage. Nutrient status in Hoagland & Arnon nutrient formulation especially N, may be employed to manipulate the anthocyanin content of vegetative tissues of cordyline plants. The results are in accordance with Stewart et al. (2000) in tomato; Khalaj et al. (2011) in gerbera; A (2012) in *Beta vulgaris*; Li & Cheng (2014) in cucumber seedlings; Mohidin et al. (2015) in oil palm seedlings grown under soilless culture system.

Table 2. Effect of different nutrient formulations on physiological parameters of *Cordyline fruticosa* grown in soilless culture system

S. No	Treatment	Chlorophyll (mg/g)	Soluble protein (mg/g)	Anthocyanin (mg/g)
1	T ₁	1.12	62.83	8.14
2	T ₂	1.64	72.35	12.8
3	T ₃	1.47	69.79	10.82
4	T ₄	1.26	63.88	9.22
5	T ₅	1.45	69.62	10.24
6	T ₆	1.42	61.91	9.76
7	T ₇	1.37	66.76	9.34
8	T ₈	1.53	70.52	11.64
9	T ₉	1.46	68.69	10.68
	Mean	1.41	68.03	10.29
	SEd	0.025	1.258	0.143
	CD (0.05)	0.050	2.645	0.306

Effect of different nutrient formulations on yield and vase life

Among the different nutrient formulations, Hoagland and Arnon- nutrient formulation (T₂) exhibited significantly the maximum yield of 7.67 leaves and vase life (10.67 days). The minimum yield (4.67 leaves) and vase life (7.00 days) was observed in

control (T₁) ((Table 3 & Fig 1). High yield quality crops can be obtained by supplying optimum mineral nutrition. Mineral nutrition of Hoagland and Arnon- nutrient formulation involves the supply, absorption and utilization of the essential nutrients required for successful growth and assimilation of metabolites and hence for the yield of the crop

plants. Vase life is the period during which cut foliage retains its appearance in a vase. Plants having more vase life are most preferable. This is because of better nutrient status,

metabolites and lower transpiration rate affected by the nutrient formulation. The results of this study are supported by the findings of Favero et al. (2011) in cordyline.

Table 3. Effect of different nutrient formulations on leaf longevity (days) and yield (number of leaves) of *Cordyline fruticosa* grown in soilless culture system

S. No	Treatment	Yield (number of leaves)	Vase life (days)
1.	T ₁	4.33	7.00
2.	T ₂	7.67	10.67
3	T ₃	6.33	8.67
4.	T ₄	4.67	7.67
5.	T ₅	5.67	8.33
6.	T ₆	5.00	8.00
7.	T ₇	5.00	7.67
8.	T ₈	6.67	9.33
9.	T ₉	6.33	7.00
	Mean	5.74	8.26
	SEd	0.497	0.471
	CD (0.05)	1.049	0.994

Fig 1. Effect of different nutrient formulations on yield (number of leaves) of *Cordyline fruticosa* grown in soilless culture system

Conclusion

From the investigation, Hoagland and Arnon- nutrient formulation was found to be the best formulation, as it recorded the highest performance in growth, physiological and yield parameters. Present results might be the first step for determining the best formulation for cordyline leaf production in soilless

culture. However, further research is definitely necessary to obtain more comprehensive results, since only a limited number of nutrient formulations were tested.

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