RESPONSE OF TARO PLANTS TO SOME PLANT STIMULANTS AND IRRIGATION LEVELS

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M.Sc. Agric. Sc., (Vegetable Crops), Ain Shams, 2006

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ABSTRACT

Amira Mohammad Mohammad Abuzeed: Response of Taro Plants to some Plant Stimulants and Irrigation Levels.. Unpublished Ph. D. Thesis, Department of Horticulture, Faculty of Agriculture, Ain Shams University, 2018.

The experiment was carried out during 2014 and 2015 seasons at El-Kanater Vegetable Research Farm, Kaliobia governorate, Horticultural Research Institute, Agricultural Research Centre. The experiment aimed to study the effect of irrigation levels, i.e. 120% 100%, 80%, and 60% of the evapotraspiration(ET), as well as some foliar spray substances , i.e. seaweed extract , potassium silicate and abscisic acid in addition to the control. The experimental treatments were arranged in a split plot design, with three replicates.

The foliar spray treatments were carried out ten times during the growing season. The first spray was followed after 8 weeks from planting date. The others were applied each two weeks. The results indicated that irrigation level at 120% of evapotraspiration gave markedly higher values of plant height , leaf number, leaf area, fresh weight, dry matter of leaves, as well as, yield, also, carbohydrates, starch, N, P, K, Ca and Mg. While the lowest values of all tested parameters, were recorded for irrigation level at 60% of evapotraspiration. The highest value for water use efficiency (WUE) was found under 80% of the evapotraspiration treatment. The results indicated also that seaweed extract and K_2Sio_3 applications increased plant height, leaf area, diameter of corms, fresh weight of corms, dry matter, leaf number, dry matter of leaves.Besides the highest values of yield, carbohydrates, starch, N,P ,K ,Ca and Mg. Also, irrigation level at 80% of evapotraspiration with seaweed extract resulted highst values of (WUE).

Generally, using 80% irrigation level accompanied by spraying seaweed extract led to a mild reduction in the plant growth, yield and quality but conferred the higher WUE compared to other interactive treatments.

Key Words: Taro, Irrigation levels, Potassium silicate, Seaweed extract, Abscisic acid, Vegetative growth, Chemical composition, Total yield and Water use efficiency.

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INTRODUCTION

Taro (*Colocasia esculenta* L. Schott) is a major crop of the Araceae family with wide distribution in the tropics and subtropics . Water is the most important limiting factor to taro yields.

It is considered one of the most important vegetables grown in Egypt due to its high nutritional and economical values. Ther are some factors that limit the increment of taro cultivation area such as its high need for fertilization , high amounts for irrigation water and its long duration in land (7-9 months). In addition, in the early period of plant growth,i.e. up to 90 days from planting,the growth rate is low which causes an increase in growing weeds.

Taro [*Colocasia esculenta* (L.) Schott] is grown throughout the humid tropics and subtropics areas **(Matthews *et al*. 2017).** Moreover, taro is considered a valuable source of essential mineral nutrients **(Mergedus *et al*. 2015)** and is high in fiber, vitamins A, C, E and B6 **(Lebot and Lawac, 2017).**

The Egyptian taro *Colocasia esculenta* (L.) Schott var. *esculenta* is planting in the Nile valley where the traditional surface irrigation method used to irrigate crops. This old method entire soil surface is almost flooded without considering the actual consumptive requirements of the crops. These practices have created the problems of waterlogging, salinity and reduction in the overall irrigation efficiency hardly up to 30 percent.

The use of modern irrigation systems becomes very important to save both water and soil. One of the most influencing operations for both production and costs is fertilizer application. Any improvement which takes place on this factor would, no doubt, have a considerably effect on production. Water use efficiency, characterized by the amount of water needed to produce a unit of plant material **(Kirkham, 2004)**, is important for Egyptian agriculture system where water resources are limited. The widely held perception that taro is one of the least water efficient crops **(Uyeda *et al*. 2011)** may, in part, explain its current low levels of utilization. It therefore comes as no surprise that information describing water use of taro and possible drought tolerance is scarce. However, information on the effect of drought on growth, development and yield of diverse taro landraces is currently lacking. According to **Lebot (2009)**, water is the most important limiting factor to taro yields. Although potatoes, sweet potatoes, and taros are highly sensitive to water deficit after planting **(Monneveux *et al*. 2013).**

The goal of deficit irrigation is to increase crop water use efficiency (WUE) by reducing the amount of water applied **(Kirda, 2002)**.

Seaweed extract are one of the most important marine resources of the world. Seaweed extracts have been marketed for several years as fertilizer additives and beneficial results from their uses have been reported **(Booth, 1965).** Seaweed concentrates are known to cause many beneficial effects on plants as they contain growth promoting hormones (IAA and IBA, Cytokinins), trace elements (Fe, Cu, Zn, Co, Mo, Mn, and Ni), vitamins and amino acids **(Challen and Hemingway, 1965)**. Liquid extracts obtained from seaweeds are successfully used as foliar sprays for several crops **(Bokil *et al*. 1974).**

Potassium nutrition is one of major factors that affect growth, yield and quality of taro. It plays a vital role for a normal cell division, translocation of carbohydrates, reduction of nitrates and particularly in meristems. **(Black, 1960; Bidwell, 1979).**

The application of silicon sources, i.e. potassium silicate ($KSiO_3$), sodium silicate ($NaSiO_3$), as foliar spray showed that Si-treated plants increased plant growth. **(Kamendou and Cavins, 2008)**.

It is actually well established that abscisic acid (ABA) plays an important role in mediating the main responses of plants to environmental stresses such as drought. Thus, ABA induces stomatal closure and reduces water loss via transpiration, which helps plants to avoid water stress **(Zeevaart and Creelman 1988; Davies and Zhang 1991)**. The ABA increased continuously under water stress and returned to control levels immediately after rehydration in several species, for instance, papaya seedlings and citrus fruits **(Mahouachi *et al*. 2005 and 2007).**

Exogenous ABA treatments prior to subjecting plants or tissues to adverse conditions have been reported to improve plant tolerance to osmotic stress **(Nayyar and Walia, 2003).**

Therefore, the aim of this study was to investigate the response of taro plants to some plant stimulants and irrigation levels on growth, yield and its components of taro grown under delta conditions.

REVIEW OF LITERATURE

In order to have a wide view on the effect of irrigation levels and some plant stimulants on taro plants, the review of literature will be divided into the following items:

2.1.Effect of irrigati on levels on vegetative growth characters,chemical contents, yield and its components.

2.2.Effect of seaweed on vegetative growth characters,chemical contents, yield and its components.

2.3.Effect of potassium silicate on vegetative growth characters, chemical contents, yield and its components.

2.4.Effect of abscisic acid on vegetative growth characters, chemical contents, yield and its components.

2.1. Effect of irrigation levels:

2.1.1. Vegetative growth:

The effect of irrigation levels on vegetative growth was studied by many investigators. In this respect, **Abou-Hadid (1978)** found that increasing soil water content significantly increased plant height, fresh and dry weight as well as eaf area index of taro plants .Similar results were reported by **Carriol and Urrutia (1979)** who found that taro plant height and cormes dry weight were greatest at the highest irrigation regime.

Ravi and Chowdhury (1991),on taro, showed that decreasing soil moister from 100 to 25 % of available water led to decreasing each of total number of leaves / plant and leaf area / plant.

Steyn *et al.* (1992) working on potato found plant growth and development were retarded by water stress , particularly at 70 % depletion of water regimes. In addition, **Kumar and Minhas (1993)** on potato mentiond that water stress at tuber initiation and its development decreased leaf area.

Sivan (1995) studied the drought tolerance in two dasheen and eddoe taro varieties, as well as tannia (*Xanthosoma sagittifolium*) and observed that stomatal conductance, leaf number and leaf area of both cultivars were decreased in response to water stress.

Fattahallah and Gawish (1997) reported that increasing of soil moisture up to the maximum level corresponding to 90% of field capacity gave the highest values of growth characters,i.e. plant height, leaf area and whole plant dry weight in taro plants.

In this concern, **Gawish and Fattahallah (1997)** showed that the irrigation levels corresponding to the 150 and 175% of ET gave the greatest values of plant height, leaf area while water stress adversely affected these growth parameters.

El-Zohiri (1999) indicated that increasing water supply increased all the studied vegetative growth parameters of taro plants ,expressed as plant height, number of leaves per plant, leaf area and fresh weight of whole plant.

Mahmoud (2006) studied the effect of water regimes of potato plants and found that increasing soil moisture up to the maximum level,i.e. irrigation by 125% of the evapotranspiration significantly increased the growth characters,i.e. plant height, number of stems,relative growth and net assimilation rates, as well as, number of leaves, leaf area index and total plant dry weight

In addition, **Mabhaudhi *et al.* (2013)** studied the effect of three levels of irrigation [30, 60 and 100% crop water requirement (ETa)] on taro using drip irrigation. Plant growth parameters (plant height, leaf number and LAI) were shown to decrease by between 5 and 19% at 60 and 30% ETa, respectively; evapotranspiration relative to 100% ETa.

El-Zohiri and AbdElal (2014) studied the effect of water stress of taro plants cv Egyptian. Obtained data indicated that surface irrigation or drip irrigation at 100 % of field capacity (FC) gave the highest results in the most of vegetative growth characters.

2.1.2. Chemical contents:

Khalak and Kumaraswamy (1992), on potato, found that nitrogen uptake was the highest with 20 or 40 mm water at irrigation water cumulative pan evaporation ratios of 0.50, 0.75, or 1.00, while the uptake of P and K were the highest when 20 mm water was given.

Gawish and Fattahallah (1997) refered that decreasing soil moister levels decreased leaf contents of N, P, K and total carbohydrates in taro.

Ravi and Chowdhury (1997) showed that the inorganic phosphorus release was maximum in leaf tissues of taro plants which grown under T3,i.e. 25 percent soil moisture saturation, than the plants which grown under 50 or 100 percent soil moisture saturation. An inorganic phosphorus release of leaf tissue was also noted in the crop growth period in taro.

Gunel and Karadogan(1998) indicated, on potato, that significant increase in starch content was found due to the frequent irrigation during the early growth stages.

Also, **El-Zohiri (1999)** indicated that, shortening the irrigation intervals from 2 to 1/2 week by intervals during the growing seasons led to significant increases in the uptake of nitrogen, phosphorus, potassium, and total carbohydrates by taro plants.

Mahmoud (2006) studied the effect of water regimes of potato plants and noted that irrigation by 125% of the evapotranspiration, gave the highest values of nitrogen, phosphorus and potassium in leaves and tubers , as well as, total carbohydrates in leaves and total protein of potato tubers. Meanwhile the lowest level of soil moisture (irrigation by 50% of the evapotranspiration) achieved the highest values of total chlorophyll and soluble sugars in leaves .

El-Zohiri and AbdElal (2014) studied the effect of water stress of taro plants cv Egyptian and indicated that surface irrigation or drip irrigation at 100 % of field capacity (FC) gave the highest results in chlorophyll a, b, total chlorophyll and carotenoids in the leaf tissues. Total carbohydrates of taro corms were significantly increased as a result of water stressed conditions compared with the control treatment.

Recently, Abu El-Azm and Youssef (2015) revealed that decreasing irrigation level from 100 to 60% of ETc reduced the N, P, K and Ca percentages in tomato leaves. . However, there was no significant difference between 100 and 80% of ETc for phosphorus percentages.

2.1.3. Yield and its components:

Concerning the effect of irrigation levels on yield and its components of taro plants, **Ezumah (1973)** found that the yield of taro was the highest with flooding and was decreased with decreasing water supply.

In addition, **Carriol and Urrutia (1979)** reported that taro yield increased with increasing soil water content from 11.3 t/ha (without irrigation) up to 33.4 t/ha at the highest irrigation regime (584mm of water applied in 58 irrigation times). Moreover, **Ravi and Chowdhury (1991)**, on taro, showed that decreasing soil moister content from 100 to 25 % led to decreasing tuber yield.

Fattahallah and Gawish (1997) reported that taro yield and its components,i.e. number of cormels / plant and average weight of both corm and cormel, increased gradually as the level of irrigation increased , where the highest watering level,i.e. 90% of field capacity, gave the highest yield values.

In this concern, **Gawish and Fattahallah (1997)** found that the three low level of irrigation regimes restricted taro yield and its physical properties,i.e. number of cormels / plant and average weight of main corm and average cormels weight, while the other two high levels gave the greatest values of these parameters and there were in siginificant differences between them.