Improvement of flowering, yield and quality attributes in acid lime (*Citrus aurantifolia* Swingle) by exogenous application of plant nutrition

Abstract

A field experiment was conducted at south farm, of Vanavarayar Institute of Agriculture, Manakkadavu, Pollachi, Tamil Nadu. The experiment was laid out in a Randomized Block Design with nine treatments and three replications. Acid lime (*Citrus aurantifolia* swingle) is an important commercial species of citrus considered to be indigenous to India, and is extensively cultivated in almost all states of India under tropical and subtropical climatic conditions. In the present investigation, the highest number of fruits per tree was observed in T_3- Panchakavya - 5% (380.80) followed by T_1- IAA - 50 ppm (350.30). The highest mean fruit weight was observed in T_3- Panchakavya - 5% (53.60) followed by T_1- IAA - 50 ppm (50.40). The treatment T_3- Panchakavya - 5% was recorded the highest per tree yield (20.41 kg) followed by T_1- IAA - 50 ppm (17.65). the highest fruit length was noticed in T_3- Panchakavya - 5% (6.50 cm) followed by T_1- IAA - 50 ppm (5.53 cm), the highest fruit girth was noticed in T_3- Panchakavya - 5% (6.86 cm) and also the highest fruit volume was recorded in T_3- Panchakavya - 5% (51.20 ml) followed by T_1- IAA - 50 ppm (48.85 ml). In this investigation, the highest Juice content (ml/100g) was noticed in T_3- Panchakavya - 5% (55.0 ml), the highest ascorbic acid content was recorded in T_3- Panchakavya - 5% (35.65mg/100g) and the highest acidity was recorded in T_4- Vemivash - 5ml (7.25%).

Keywords: acid lime, growth regulators, botanicals, yield, quality characters.

Introduction

Citrus production is 108 million tons in the world. Brazil is the largest producer of citrus worldwide followed by USA, China and Mexico. Pakistan is among the top thirteen citrus producing countries of the world. The use of growth regulators has become an important component of agro technical procedures for most of the cultivated plants and especially for fruit plants (Monselise, 1979). So in citrus fruits, excessive fruit drop can be controlled by the exogenous application of plant growth regulators. The auxins and gibberillins are used to control the fruit drop in citrus and to improve the quality of fruit (Almeida *et al.*, 2004). Although some references are available in the literature and efforts have been made to control the fruit drop by exogenous application of growth regulators but

there is no precise recommendation for the control of fruit drop in acid lime. The purpose of the present study was to evaluate different growth regulators and botanical of acid lime cv. PKM1, with emphasis on their agronomic performance, yield attributing characters. Plant growth regulators and botanical applied near the terminal buds of trees may increase the rate of growth by stimulating more or less constant growth during the season. Plant growth regulators and botanic are used mainly to delay and reduce unwanted fruit abscision (fruit drop), to delay the senescence and to promote abscision of exces fruit (thinning to increase the size of the remaining fruit) and to inhibit the growth of suckers on the trunk. Foliar feeding is one of the ways towards this goal, because there by nutrients are aplied directly to the site of their metabolism and are not subjected to loses as in case of soil aplication. IAA increase the flowering, fruit set, fruit size and control the fruit drop and ultimately increase the yield (Awasthi *et al*., 1975). So there was a need to test the efficacy of plant growth regulators and botanicals to reduce fruit drop and improve the quality and yield under agro-environmental conditions of tropical region of Tami Nadu.This research was initiated as a preliminary effort however it is well planned and it provides necessary efficacy data for the registration of use of plant growth regulators (PGRs) and botanicals on acid lime.

The acid lime tress under Tamil Nadu conditions flower normally twice a year during January - February and June – July and yield fruits mainly during July – August and December –January Shrestha (1988).

Materials and methods

An investigation on "Studies on enhancement of yield and post-harvest quality in acid lime (*Citrus aurantifolia* Swingle)" was undertaken at Vanavarayar Institute of Agriculture Manakkadavu, Pollachi during the year 2014- 2015. Which is located at 10.6 ^{0} N and 77 ^{0} E with an altitude of 105 m above MSL. The experiment was laid out in randomized block design with replicated three times. Seven years old acid lime tree of uniform age, size and stature, spaced at 5x5m were selected for the experiment. Four trees were selected for each variety in each replication for the study. The treatment details viz., T_1- IAA - 50 ppm, T_2- GA_3 - 50 ppm, T_3- Panchagavya - 5%, T_4- Vemivash - 5ml, T_5- Neem extract - 5%, T_6- Moringa leaf extract - 5%, T_7- Tender coconut water - 5%, T_8- Water spray and T_9- Control

Result and Discussion

Influence of growth regulators and botanicals on yield characters

The aim of any applied research is to maximize the yield. Yield in any crop is a multiplicative factor of fruit size and number of fruits, harvested from the tree. Flowering and fruit set are the most critical events occurring after establishment of a crop (Davenport and Nunez- Elisea, 1990). Other possible inductive factors in flowering can be proper nutrition (carbohydrate and nitrogen status of the plant), photoperiod and plant hormones, and other yet undetermined factors (Bernier *et al*., 1981). In the present investigation, Application of different levels of growth regulators and botanicals through foliar application has caused a significant effect on the 'number of fruits per tree'. The number of fruits per tree ranged from 235.80 to 380.80. The highest number of fruits per tree was observed in T_3- Panchakavya - 5% (380.80) followed by T_1- IAA - 50 ppm (350.30). The highest mean fruit weight was observed in T_3- Panchakavya - 5% (53.60) followed by T_1- IAA - 50 ppm (50.40) and the per tree yield ranged from 9.45 to 20.41 kg. The treatment T_3- Panchakavya - 5% was recorded the highest per tree yield (20.41 kg) followed by T_1- IAA - 50 ppm (17.65) (Fig 1). According to Marschner (1995), a balanced supply of nitrogen promoted the translocation of phytohormones to the shoot, probably inducing the flower and fruit initiation. In the present investigation, the important economic traits namely, fruit weight and number of fruits were dramatically influenced by different levels of growth regulators and botanicals. This is might be due to the higher levels of IAA in the leaves of the branches that produced more flowers in late February suggested the involvement of IAA in flower-bud development.

Influence of growth regulators and botanicals on fruit physico-chemical characters

In the present investigation, the highest fruit length was noticed in T_3- Panchakavya - 5% (6.50 cm) followed by T_1- IAA - 50 ppm (5.53 cm), the highest fruit girth was noticed in T_3- Panchakavya - 5% (6.86 cm) followed by T_2- GA_3 - 50 ppm (5.91 cm) and also the highest fruit volume was recorded in T_3- Panchakavya - 5% (51.20 ml) followed by T_1- IAA - 50 ppm (48.85 ml). This is might be due to basically, GA_3 and IAA promote cell division in plant tissue (Gardner *et al*., 1985; Letham, 1958) which may cause the development of bigger size fruits and fruit girth . Endogenous level of these hormones fall much lower level within a few days after flowering (Guardiola, 1993). So, exogenous application of these hormones at petal fall and thereafter caused rapid cell division in the pericarp of the fruits. Warusavitharana *et al*. (2008) also reported that IAA increased the number of cell layers in the fruit cortex while GA_3 causes cell expansion resulting bigger size, length berries in grape by combined application of GA_3 and IAA.

Influence of growth regulators and botanicals on quality attributes

In any production system, the primary goal is to achieve maximum fruit yield per unit area without affecting the fruit quality. In mango, the quality is mainly judged by total soluble solids (TSS), juice content, ascorbic acid and acidity content in fruits. Application of nutrients, either through soil (or) foliar, has made a remarkable effect on fruit quality as observed by Syamal and Mishra (1988), Suriyapananant (1992) and Shah *et al*. (2002). In this investigation,The highest Juice content (ml/100g) was noticed in T_3- Panchakavya - 5% (55.0 ml) followed by T_1- IAA - 50 ppm (52.0 ml), the highest ascorbic acid content was recorded in T_3- Panchakavya - 5% (35.65mg/100g) followed by T_1- IAA - 50 ppm (34.20mg/100g) and the highest acidity was recorded in T_4- Vemivash - 5ml (7.25%) followed by T_3- Panchakavya - 5% (6.90%) (Fig 1). The growth regulators treatments had an increasing trend towards TSS, total sugars and reducing sugars which is a good sign and the treatments might be selected for the improvement of fruit quality of different varieties although many scientists had reported no effect of growth regulators on fruit quality parameters like TSS, sugars, acidity, TSS/ acidity ratio etc, (Lima and Davies, 1984; Stewart and Klotz, 1947; Hield *et al*., 1965). Although there were significant differences among treatments in case of acidity, vitamin -C and TSS/ acidity ratio yet most of the treatments are sharing the same letters.

Conclusions

The present findings clearly indicate that foliar application of T_1-IAA - 50 ppm,T_2-GA_3 - 50 ppm,T_3-Panchagavya - 5%,T_4-Vemivash- 5ml,T_5-Neem extract - 5%,T_6-Moringa leaf extract - 5%,T_7-Tender coconut water - 5%,T_8-Water spray,T_9-Control. Among the treatments T_3-Panchagavya - 5%, and T_1-IAA - 50 ppm is effective in improving flowering ,fruit yield and juice quality by increasing juice volume/contents, pH, TSS, ascorbic acid, and TSS/acid ratio of juice and providing the maximum control on excessive drop of premature acid lime fruit. Therefore, foliar spray of T_3-Panchagavya - 5%, and T_1-IAA - 50 ppm at the onset of flowers and fruit formation is suggested to maximize the production of acid lime as well as other citrus fruits.

References

A. O. A. C. 1970. Official methods of analysis. Association of official analytical chemists. 11th Edn; Washington, D. C.

Bernier, G., Kinet, J.-M. and Sachs, R. M. (1981). The Physiology of Flowering, Volumes I and II. CRC Press, Boca Raton

Davenport TL and Nunez–Elisea R 1990. Ethylene and other endogenous factors possibly involved in mango flowering. Acta Horticulturae 275: 441- 448.

Gardner, F.P., R.B. Pearce and R.L. Mitchell, 1985. *Physiology of Crop Plants*. Iowa State Univ. Press, Ames, Iowa. pp. 156-186.

Guardiola, J.L., M.T. Barres, C. Albert and A. Garcia-Luis, 1993. Effect of exogenous growth regulators on fruit development in *Citrus unshiu. Ann. Bot.*, 71: 169-176.

Letham, D.S. 1958. Cultivation of apple-fruit tissue *in vitro. Nature*, 182: 473-474.

Lima, J.E.O. and F.S. Davies. 1984. Growth regulators, fruit drop, yield and quality of Navel orange in Florida. J. Amer. Soc. Hort. Sci., 109 (l): 81-84.

Marschner.H.1995. Mineral nutrition of higher plants 2nd Edition Academic press San Diego. 889 pp.

Stewart, W.S., L.J. Klotz and H.Z. Hield. 1951. Effects of 2, 4-D and related substances on fruitdrop, yield, size and quality of Washington navel oranges. Hilgardia, 21: 161-93

Warusavitharana, A.J., T.B. Tambe and D.B. Kshirsagar, 2008. Effect of cytokinins and brassinosteroid with gibberellic acid on yield and quality of Thompson Seedless grapes. *Acta Hort.*, 785: 217-223.

Fig 1. Influence of exogenous application of plant nutrition on yield attributes

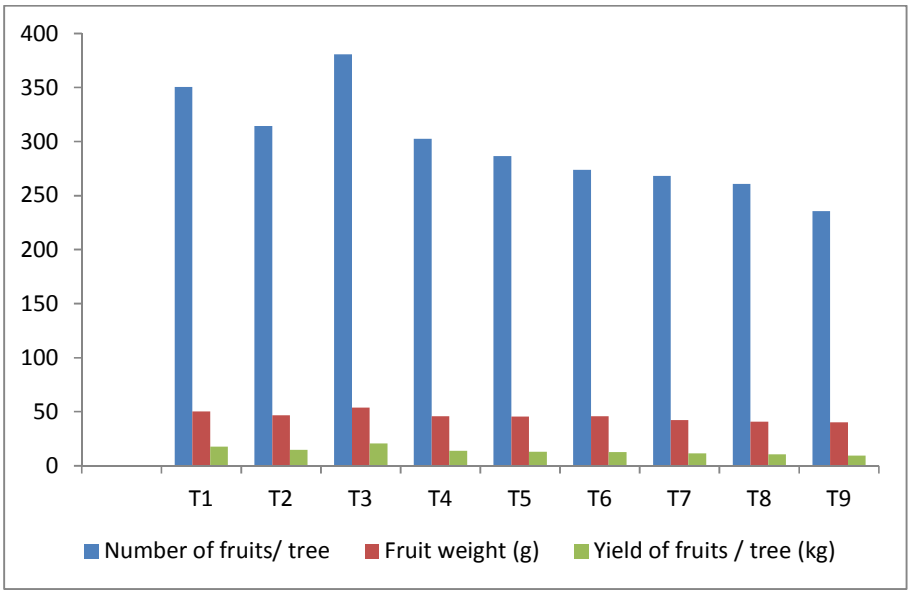

Table 1. Influence of exogenous application of plant nutrition on floral, fruit set and quality attributes

Treatments	Fruit length (cm)	Fruit girth (cm)	Fruit volume (ml)	Juice content (ml/100g)	TSS ^{0}Brix	Ascorbic acid content (mg/100g)	Acidity (%)
T_1- IAA @ 50 ppm	5.53	5.44	48.85	52.00	7.10	34.20	6.70
T_2- GA_3 @ 50 ppm	5.29	5.91	45.20	47.00	6.50	33.17	6.30
T_3- Panchakavya @ 5%	6.50	6.86	51.20	55.00	7.70	35.65	6.90
T_4- Vemivash @ 5ml	4.77	5.03	44.85	45.00	6.75	33.49	7.25
T_5- Neem extract @ 5%	4.55	4.95	43.27	42.00	6.50	33.40	6.50
T_6- Moringa leaf extract @ 5%	4.30	4.44	43.90	42.70	6.30	33.50	5.85
T_7- Tender coconut water @ 5%	4.25	4.40	44.25	40.00	6.50	32.70	6.15
T_8- Water spray	4.10	4.35	38.75	37.80	6.10	32.95	6.30
T_9- Control	4.00	4.13	37.50	35.60	6.00	32.15	5.40
SEd	**0.25**	**0.26**	**2.37**	**2.32**	**0.34**	**1.77**	**0.34**
CD (0.5%)	**0.54**	**0.56**	**5.08**	**4.97**	**0.74**	**3.80**	**0.73**