

Improving Nutritional Status and Productivity of Balady Mandarin trees using some Biostimulants and Antioxidants



Badawy, Sabah M.¹; Ibtesam F.M. Badawy² and R.A.Ibrahim²

¹Agricultural Research Center, Shandawel Sohag.

²Pomology Department. Faculty of Agriculture, Assiut University

Accepted for publication on: 10 /11/2021

Abstract

This study was conducted during two successive seasons of 2018 and 2019 on Balady Mandarin trees, 20 years old budded on sour orange rootstock and planted at 5×5m apart. Grown at the productive farm located at Shandawel Island, Sohag governorate. This experiment aimed to study the effect of active dry yeast, ascorbic acid, vitamin B complex and their combination on yield components, alternate bearing and fruit quality of Balady Mandarin cultivar grown under Sohage conditions. The obtained results showed that using of active dry yeast at 10g/l (as soil application) as single application or in combination with ascorbic acid and vitamin B complex at 1g/l from each (foliar application) caused a pronounced increasing of fruit numbers, fruit weight (g) and yield (kg). The later also improved fruit quality in terms of TSS%, TSS/acid ratio as well as total sugars, vitamin C content and reducing total acidity of Balady Mandarin fruits. According to results of the current study it could be concluded that using active dry yeast at 10g/l (as soil application) as single treatment or in combination with spraying ascorbic acid (1g/l) plus vitamin B complex (1g/l) three times on the first week of May, July and September led to improve both yield and fruit quality of Balady Mandarin Cultivar under Sohage environmental conditions.

Keywords: *Citrus, Balady Mandarin, Active dry Yeast, Ascorbic acid, Vitamin B complex.*

Introduction

Citrus is a native tree of tropical and subtropical regions. It is an important cash crops and rich source of Ascorbic acid. Mandarin occupies the second planted citrus species after orange.

Recently, many researchers investigated the importance of Biostimulants and antioxidants to improve yield and fruit quality instead of using various chemicals in order to reduce the environmental pollution.

Biostimulants are organic compounds which cause a biochemical activity in plants, increasing the uptake of necessary nutrients. Biostimulants applied as a soil application or

tree foliage induce chemical changes in living cells by which energy is provided for vital processes and activities. Biostimulants had many benefits such as increasing the root biomass, trans locating nutrient, activating enzyme, and promoting nutrient uptake. Biostimulant include vitamins, minerals, amino acids, polysaccharides, oligosaccharides, and other natural substances like humic acids, seaweed (kelp) extracts, mycorrhizal spores, and bacteria which improve soil conditions and positively affect crop physiology and plant metabolism. Moreover, they are also capable for increasing plants efficiency' and nutrient uptake by changing soil con-

ditions, nutrient solubility, and root morphology. Plant biostimulants can reduce the required level of inorganic fertilizer to optimize yield. Bulgari, *et al.*, (2019) and Van Oosten, *et al.*, (2017)

Yeast (*Saccharomyces cerevisiae*) is considered as a biofertilizer for many crops. Yeast is characterized by its richness in protein and vitamin B group. Also yeast is prolific producer vitamins, amino acid, hormones and growth regulating substances (Harrison, 1968). In addition, using active dry yeast was very effective in stimulating photosynthesis as a result of releasing carbon dioxide (Larson *et al.*, 1962 and Subba Rao, 1984).

Vitamins with their antioxidant properties have an important role in plant defence against oxidative stresses induced by unfavourable conditions. Vitamin compounds play an important roles in yield and plant disease resistance, which are consider a key to increas agricultural productivity.

Ascorbic acid participates in a variety of processes such as photosynthesis, cell wall growth and cell expansion, environmental stresses resistance, ethylene, gibberellins synthesis and it has been implicated in several types of biological activities in plants such as antioxidants. Nicholas Smirnoff (1996) and Smirnoff and Wheeler (2000).

This investigation aimed to study the effect of some natural organic biostimulants including yeast, ascorbic acid and vitamin B complex and their combinations on vegetative growth, yield, fruit quality and reduc-

ing alternate bearing of Balady mandarin trees.

Materials and Methods

Our study was carried out during 2018 and 2019 seasons on 30 Balady Mandarin (*Citrus reticulata*) trees 20 years old, uniform in vigor and budded on Sour Orange rootstock. The trees grown at Shandawel Islan, Sohag governorate, where the soil is clay and well drained. Tree spacing is 5x5 meter apart, surface irrigation system was followed.

The selected trees were treated three times on May, July and September with vitamin B complex (B1 + B2 + B6 + B12) at 1 g/L, ascorbic acid at 1 g/L or active dry yeast at 10 g/L which add as soil application and their combinations.

This investigation included 5 treatments as follows:

- 1- Control (spraying with water)
- 2- Soil application with active dry yeast at 10 g/L.
- 3- Spraying with ascorbic acid at 1 g/L.
- 4- Spraying with vitamin B complex at 1 g/L.
- 5- Soil application with active dry yeast at 10 g/L + spraying with ascorbic acid at 1 g/L + vitamin B at 1 g/L.

All the previous treatments were executed three times on the first week of May, July and September.

Sida film as wetting agent was added to vitamin B complex solution at 0.05%.

All the trees were sprayed till runoff (20 L/tree).

Treatments were arranged in a randomized complete block design (RCBD) with three replicates per treatment two trees each.

The parameters which measured during the two studied seasons include:

(A) Yield components and Fruit quality:

At commercial harvest (color break) on mid-December in the two seasons, the number of fruits /tree were counted.

Ten fruits were taken randomly from each tree to estimate physical fruit properties. Fruit weight was determined and yield (kg/tree) was estimated. Chemical properties of juice including total soluble solids % were determined by using a hand refractometer. Total sugar % was determined using Lane and Eynon Volumetric method (A.O.A.C., 1995), total acidity % (expressed as citric acid) by titration with 0.1 NaOH using phenolphthaline as an indicator (A.O.A.C., 1995). TSS/acid ratio was then calculated. Vitamin C content (as mg ascorbic acid /100 ml juice) was determined by titration against 2,6 dichlorophenolindophenol Dye according to (A.O.A.C., 1995).

(B) Nutrient status:

Fifty mature leaves of a seven month age from the non-fruiting shoots of the spring flush were randomly taken from each replication in mid-October to determine the leaf nutrient content. As well as to determine the shoot nitrogen %, The leaf samples were washed with tap water and distilled water then both leaf and shoot samples were air-dried, oven-dried at 70°C to a constant weight, ground in a stainless steel mill and kept for chemical analysis (Nijjar, 1985). The ground sample was analyzed for total nitrogen by the semi-microkjeldahl technique (Dremner

and Mulvaney, 1982 and Wild *et al.*, 1985).

The obtained data were statistically analyzed according to Gomez and Gomez (1984). The mean of the treatments were compared using L.S.D test at level of 0.05.

Results

(A) Effects of yeast extract, ascorbic acid as well as vitamin B complex on yield components of Balady mandarin trees:

Data from Table (1) showed clearly that all treatments significantly increase yield (kg) of Balady mandarin trees compared with controls during the two studied seasons. Where applications significantly increase the total number of fruit per tree at harvest time. The best results of yield were obtained from trees that treated with combination treatment (active dry yeast at 10 g/L as soil application plus ascorbic acid and vitamin B at 1 g/L as foliar spraying). Since, this treatment gave the highest yield and number of fruits per tree followed by active dry yeast as a single treatment. Where the average No. fruit/tree and yield associated with these treatments were (361.33 & 372.67 fruit/tree), (52.507 & 65.623 kg/tree) and (332.67 & 338.33), (44.80 & 56.613) comparing with control which recorded (274.67 & 274.00 fruit/tree) and (32.047 & 35.903 kg/tree), respectively, during 2018 and 2019 seasons.

Data from the same table reported that all treatments significantly increased fruit weight of Balady mandarin, compared with controls during the two studied seasons.

The highest values in this term were obtained from trees treated with

combination treatment (active dry yeast at 10 g/L as soil application plus ascorbic acid and vitamin B at 1 g/L as foliar spraying) followed by active dry yeast 10 g/l and ascorbic acid as a single treatment in a de-

scending order comparing with control treatment. The values due to these treatments were (160.665, 151.00 and 143.33g) while control treatment gave (123.835g) as an average of the two seasons respectively.

Table 1. Effect of Active dry yeast, Ascorbic acid and Vitamin B complex on the Number of fruits/tree, fruit weight (g) and yield (kg) of Balady mandarin Cultivar during 2018 and 2019 seasons.

Treatments	Fruit number		mean	Fruit weight(g)		mean	Yield (kg)		mean
	2018	2019		2018	2019		2018	2019	
Control	274.67	274.00	274.33	116.67	131.00	123.835	32.047	35.903	33.975
Active Dry Yeast	332.67	338.33	335.50	134.67	167.33	151.00	44.80	56.613	50.707
Ascorbic acid	318.33	321.33	319.83	126.33	160.33	143.33	40.22	51.520	45.87
Vitamin B coplex	305.00	305.33	305.16	127.00	142.00	134.50	38.737	43.367	41.052
Yeast+V.B. + Ascorbic acid	361.33	372.67	367.00	145.33	176.00	160.665	52.507	65.623	59.06
LSD 5%	5.403	8.734		5.737	5.924		2008	3.077	

(B) Effects of active dry yeast, ascorbic acid and vitamin B complex on chemical properties of Balady mandarin fruits:

Data concerning the studied chemical constituents of Balady Mandarin fruit juice are demonstrated in Table (2) reported that all the treatments increased TSS % of Balady mandarin fruits during the two studied seasons.

The best results were registered from trees that treated with combination of yeast+ ascorbic acid + vitamin B complex. The best total soluble solids recorded were 12.467 & 13.176% comparing with control (11.767 & 11.233%), respectively in 2018 and 2019. On the other hand, all treatments slightly decreased total acidity% compared with control, while the combination treatment (yeast + ascorbic acid + vitamin B complex)

significantly decreased total acidity values which recorded 0.822 & 0.741% compared with control (1.251 and 1.003%), respectively, during 2018 and 2019 seasons.

All treatments slightly increased TSS/acid ratio, while the combination of (yeast + Ascorbic acid + Vitamin B) significantly increased TSS/acid ratio, which recorded 15.383 & 17.773 compared with control which recorded 8.397 & 11.2, during 2018 and 2019 seasons respectively.

Data obtained from the same Table cleared that all the treatments increased total sugars %. The combination treatment gave the highest values followed by active dry yeast and ascorbic acid comparing with untreated trees. The values of total sugars % were 9.94, 9.5 and 9.394% due to the combination treatment, active dry yeast and vitamin B complex

treatments respectively against the check treatment (7.84%) as an average of the two studied seasons. Concerning the active dry yeast, ascorbic acid, vitamin B complex and their combination effects on Balady Mandarin fruits juice content of vitamin C results indicated that all treatments enhanced vitamin C content. The maximum values were 57.667, 55.00 and 53.167 mg/100 ML juice due to the combination treatment, active dry yeast and ascorbic acid respectively while the lowest value obtained from untreated trees (45.0 mg/100 ml

juice) as an average of two studied seasons.

Table 2 showed leaves nitrogen content. All treatments slightly increased N% except the combination treatment with (yeast + ascorbic acid + vitamin B) which significantly enhanced N%. Combination treatment gave the highest N% followed by active dry yeast while the lowest one obtained from the control treatment. The values of these treatments were 4.371, 3.808 and 2.999% respectively as an average of the two seasons.

Discussion

Recently biositmulants and antioxidants were found to enhance Citrus yield and fruit quality. The obtained results showed that using active dry yeast 10g/l (as soil application) as a single treatment or in a combination with spraying ascorbic acid 1g/l plus vitamin C complex 1g/three times at the first week of May, July and September had a positive effect on improving trees nutrient status, increasing yield and its components and improving fruit quality of Balady Mandarin cultivar. These results may be due to Yeast high content of mineral such as N,P,K, proteins vitamins, Natural hormones I.e. Cytokinin and IAA. The application of active dry yeast induced an improving of hormones and accumulation of carbohydrates consequently raising sugars in fruit. Vitamins, chelating agents and enzymes have stimulate cell division and enlargement improve nutrients uptake protein synthesis and improve net photosynthesis Moor (1979) and Idso *et al.*,(1995).

Ascorbic acid positive effect may be ascribed to its role in many processes such as photosynthesis, cell wall growth, cell expansion, environmental stresses resistance and synthesis of ethylene, gibberellins and its role as antioxidant. (Smirnoff and Wheeler, 2000). The promoting effect vitamin B Complex on growth traits, yield and fruit quality may be attributed to its important roles in plants disease resistance and yield improving.

Our results are in the same line with those obtained by Verna (1990) who reported that uptake of nutrients greatly enhanced in response to bio

fertilization of Citrus trees. These results were in harmony with those obtained by Ebrahiem *et al.*, 2000; Mostafa and El-Hosseiny 2001; Badawy., 2005; El-Salhy *et al.*, 2006; Bakry, 2007; Mohamed., 2008; EL-Khafagy *et al.*, 2010 and Abo-Zeed *et al.*, 2014, who reported that application of yeast at different concentrations was very effective in stimulating yield of different citrus tree cultivars. And Samra *et al.*, 2012, who reported that spraying mandarin trees and Washington Navel orange trees with ascorbic acid at different concentrations, increased the yield per tree than the control. Also, Vitamin B benefits on grapevine cultivars growth and fruiting were emphasized by the finding of Abd El-Razek, 2013; and Ahmed *et al.*, 2014.

According to the obtained results of our study it could be concluded that using active dry yeast at 10g/l (as soil application) as a single treatment or in combination with spraying ascorbic acid (1g/l) plus vitamin B complex (1g/l) three times on the first week of May, July and September resulted in enhance the nutrition status and improve both yield and fruit quality of Balady Mandarin Cultivar under Sohage environmental conditions.

References

- Abd El-Razek, E.; A.S.E. Abd-Allah and M.M.S. Saleh (2013). Foliar spray of some nutrient elements and antioxidants for improving yield and fruit quality of Hindi Mango trees. Middle-East Journal of Scientific Research 14 (10): 1257-1262, 2013.
- Abo-Zeed, Eman A.A.; A.M. El-Salhy; H.A. Abdel-Galil and Ebtesam F.M. Badawy (2014). Effect of

- yeast and different phosphorus fertilizer sources on growth and fruiting of Balady mandarin trees. *Assiut J. Agric. Sci.*, 45 (3): 49-64.
- Ahmed, F.F.; A.M. Moawad; A.H. Yousef and S.H.E. Hassan (2014). Attempts for reducing alternate bearing in Balady mandarin trees by spraying some amino acids and vitamins. *World Rural Observations*, 6 (2): 48-57.
- A.O.A.C. (1995). *Official Methods of Analysis*. The Association of Official Analytical Chemists. Arlington, West Virginia, USA 15th Ed. Washington, D.C.
- Badawy-Sabah, M. (2005). Histophysiological effects of yeast and kinetin application on fruit characteristics and fruit growth stages of Balady mandarin cultivar. Ph.D. Thesis, Hort. Pomology Fac. Agric., Assiut University, Egypt.
- Bakry, K.H.A. (2007). Response of Jafa orange trees to spray with yeast extract and promalin. *Egypt. J. Appl. Sci.*, 22 (10A): 195-210.
- Bulgari, R.; Franzoni, G.; Ferrante, A. Biostimulants application in horticultural crops under abiotic stress conditions. *Agronomy* 2019, 9, 306.
- Dremner, J.M. and C.S. Mulvaney (1982). Nitrogen total, p. 505-624. In A.L. Page, R.H. Milel and D.R. Keeney (eds.). *Methods of Soil Analysis*. Part 2. Chemical and Microbiological properties 2nd ed. Am. Soc. Agron. Madison, Wisconsin, USA.
- El-Khafagy, S.A.A.; N.S. Zaied; M.M. Nageib; M.A. Saleh and A.A. Fouad (2010). The beneficial effects of yeast and zinc sulphate on yield and fruit quality of Navel orange trees. *World J. of Agri. Sci.* 6 (6): 635-638.
- El-Salhy, A.M.; H.M.M. Marzouk and T.M.A.A. (2006). Physiological studies on the effect of active dry yeast application on Balady mandarin trees. *Pross. Of the 3rd Int. Conf. for Develop. And the Env. In the Arab World*, March 21-23.
- GGomez K.A., and Games, A.A. (1984) *Statistical Procedure for Agricultural Research* 2nd Ed. John Willy. Ny. Pp:680
- Harrison, J.S. (1968): Characteristics of food yeast. *Proc. Biochem.*, 8: 59-62. (1 the yeast 3, 1970, Rose, A.H. and J.S. Harrison, A Cad. Press, New York and London).
- Ibrahiem, T.A.; F.F. Ahmed and E.A. Abo El-Komsan (2000). Response of Balady mandarin trees grown and sandy soil to spraying active dry yeast and some macronutrients. *Assiut J. Agric. Sci.*, 31 (5): 41-54.
- Iidso, S.B.; K.E.Idso; R.L.Garcia; B.A.Kimball and J.K., Hoober (1995). Effect of atmospheric co2 enrichment and foliar methanol application on net photosynthesis of sour orange trees (*Citrus aurantium*, Rutaceae) leaves. *American. J. of Botany*, 82(1):26-30.
- Larson, P.; A. Herbo; S. Klangson and T. Ashain (1962). On the biogenesis of some compounds in *Acetobacter Xyliam*. *Plant Physiol.* 15: 552-565.
- Mohamed, O.A.F. (2008). Response of Balady mandarin trees to foliar application with active yeast and some microelements. M.Sc. Faculty of Agriculture, Moshtohor, Benha University, Egypt.
- Moor, T.C.(979). *Biochemistry and physiology of hormones*. Pub.By Springer-Verlag, New York, U.S.A.
- Mostafa, M.F. and A.A. El-Hosseiny (2001). Influence of spraying active dry yeast solution on growth, yield, fruit quality and leaf NPK content of Washington Navel or-

- ange trees. J. Agric. Sci. Mansoura Univ., 26 (100): 6293-6305.
- Nicholas Smirnoff (1996). The Function and Metabolism of Ascorbic acid in plants. *Annals of Botany* 78:661-669.
- Nijjar, G.S. (1985). Nutrition of fruit trees. Mrs. Usha Raj Kumar for Kalyanin Publishers, New Delhi, p. 10-52.
- Samra, N.R.; M.I. El-Kady; E.E.T. El-Baz and M.S.H. Ghanem (2012). Studies towards for effect of some antioxidants on yield and fruit quality of Balady mandarin trees (*Citrus reticulata*, Blanco). *J. of Plant Production, Mansoura Univ.*, 3 (1): 51-58.
- Smirnoff, N. and G.L. Wheeler, (2000). Ascorbic acid in plants Biosynthesis and Function. *Current Review in plant Sciences*. 19: 267-290.
- Subba-Rao, N.S. (1984). *Biofertilizer in Agriculture*. Oxford IBH Company, New Delhi.
- Van Oosten, M.J.; Pepe, O.; De Pascale, S.; Silletti, S.; Maggio, A. The role of biostimulants and bioeffectors as alleviators of abiotic stress in crop plants. *Chem. Biol. Technol. Agric.* 2017, 4, 5.
- Verna, L.W.(1995). Role of Biotechnology in Supplying plant nutrients in varieties. *Fertilizer News*. 35:87-97.
- Wild, S.A.; B.B. Gorey; J.G. Layer and J.K. Voigt (1985). *Soils and Plant Analysis for tree culture*. Published by Mohan Pramlani, Oxford and IBH Publishing Co., New Delhi, p. 1-142.

تحسين الحالة الغذائية والإنتاجية لأشجار اليوسفي البلدي باستخدام بعض المنشطات الحيوية ومضادات الأكسدة

صباح محمد بدوي^١ وابتسام فتحي محمد بدوي^٢ ورشاد عبد الوهاب إبراهيم حسن^٢

^١مركز بحوث محطة شندويل

^٢قسم الفاكهه ، كلية الزراعة ، جامعة اسيوط

الملخص

أجريت هذه الدراسة خلال موسمين متتاليين ٢٠١٨ و ٢٠١٩ علي أشجار اليوسفي البلدي عمر ٢٠ سنة مطعومة علي أصل النارنج ومزروعة علي مسافة ٥×٥ متر بالمزرعة الإنتاجية بجزيرة شندويل – محافظة سوهاج.

تهدف التجربة لدراسة تأثير الخميرة الجافة النشطة وحمض الأسكوربيك وفيتامين ب ١٢ كمعاملات فردية أو مزدوجة منهم علي مكونات المحصول وجودة ثمار اليوسفي البلدي تحت ظروف محافظة سوهاج.

أوضحت النتائج أن استخدام الخميرة الجافة النشطة بتركيز ١٠ جم/لتر (إضافة أرضية) كمعاملة فردية أو مزدوجة مع كل من حمض الأسكوربيك ١ جم/لتر وفيتامين ب ١٢ (١ جم/لتر) رشاً علي الأشجار أحدثت تأثير ملحوظ علي زيادة عدد الثمار/شجرة ووزن الثمرة (جم) وكذلك المحصول (كجم) كما أنها حسنت من جودة الثمار فيما يتعلق بنسبة المواد الصلبة الذائبة الكلية ونسبة المواد الصلبة الذائبة الكلية إلي الحموضة وكذلك محتوى الثمار من السكريات الكلية وفيتامين ج كما حسنت الحالة الغذائية للأشجار من حيث محتوى الأوراق من التيتروجين بينما قللت من الحموضة الكلية لثمار اليوسفي البلدي.

طبقاً لنتائج هذه الدراسة يمكن التوصية باستخدام الخميرة الجافة النشطة بتركيز ١٠ جم/لتر (إضافة أرضية) كمعاملة فردية أو معاملة مزدوجة مع حمض الأسكوربيك وفيتامين ب ١٢ بتركيز ١ جم/لتر (رشاً علي الأشجار) ثلاث مرات في الأسبوع الأول من شهر مايو ويوليو وسبتمبر لتحسين الحالة الغذائية للأشجار وكلاً من المحصول وجودة ثمار اليوسفي البلدي تحت ظروف محافظة سوهاج المناخية.