Studii şi Cercetări	Martie 2016	Biologie	25/1	32 -37	Universitatea"Vasile Alecsandri" din Bacău

DETERMINATION OF NUTRITIONAL ACTIONS OF ASFAC BCO-4 STIMULATOR IN FRUIT TREES CULTURE IN ECOLOGICAL SYSTEM

Simona Andrei, Ioan-Viorel Raţi, Dumitra Răducanu, Nicoleta Bădăluţă

Key words: *ecological fertilizer, phytochemical indicator, bioproductive indicator, biometric measurement, apple, growing season*

INTRODUCTION

Increased fruit consumption leads producers to develop efficient production systems. This implies establishing cultures with maximum productivity at minimum cost.

In addition to increased productivity, there should also be considered fruit quality and aspect. Organoleptic properties and nutritional value of fruits are decisive factors on the consumption market (2, 21).

To meet these desiderata, manufacturers come up with solutions to fertilize crops with non-toxic stimulants and maximum return. One of these stimulators is ASFAC BCO-4. This product is non-toxic and of maximum profitability, allowing the successful realization of crops that are superior both in terms of quantity and quality (4, 12, 22). This paper aims to demonstrate the superior qualities of the bio-stimulator ASFAC BCO-4.

To this effect, there were performed: fruit biometric measurements; length and weight of fruit stems, bioproductive indicators, such as pulp density; phytochemical indicators that included determination of dry matter content, sugar content and fruit acidity. Regarding organoleptic appreciation, it was considered the fruit aspect, namely the shape, size and colour as well as pulp properties, namely consistency, taste and savour (1, 14, 15, 16, 22).

It is also important to apply tending operations accordingly and the necessary nutritive stimulators at the right time. Compliance with these parameters leads to valuable productions in terms of both quality and quantity (4, 8, 21).

MATERIAL AND METHODS

Study area

The research was conducted in a 23-year-old apple orchard with apple-trees grafted on the parent stock M-106, located in the Şerbăneşti neighbourhood from the agricultural area of the city of Bacău. The planting distance is 4 m between rows and 1.5 m between trees in a row, with intensive pruning (spindle-bush) and a density of 1675 trees/ha (18).

Fig. 1. Apple tree, Golden delicious variety

There were studied the following varieties:

Jonathan: It is characterized by medium-sized fruits (120 -130 g) with tapered shape. The peel is thin, of a lively red. The pulp is yellowish, juicy, sweet, slightly acidic. The harvesting period is September. The preservation period: September to March. Pollinator: Golden Delicious (2, 6).

Idared. It is a fruit of large size (170 - 200 g), with spherical-flattened shape, with raspberry-red colour with wide stripes of a more intense red, the pulp is juicy, acidic and sweet. Harvesting period: October 1st. Preservation period: October to March. Pollinator: Ionagold (2, 5, 11, 22).

Golden delicious. It is a tree of medium vigour that grows fruit on long branches with many shoots (Fig.1.). It is characterized by sensitivity to diseases, but is productive and of high quality. The fruits preserve well if harvested properly. They are large, ribbed, sphero-conical, with large and rare rust spots. The pulp is yellow, crisp, juicy, markedly sweet, and slightly acid, with pleasant aroma. Ii is a variety preferred by most consumers. The fruits are large or medium: 140-180g can be kept between 6 to 8 months in special storage conditions (6, 11, 19).

Productused in fertigation

ASFAC BCO-4 is a bio-stimulator that has universal application in agriculture, viticulture, horticulture and forestry. If applied properly, it leads to substantial increases in agricultural production. In addition to increasing agricultural production, there also occurs an increase in product quality (9, 20).

ASFAC BCO-4 is devoid of toxicity, being the only non-toxic fertilizer that can be applied at any stage of vegetation even during flowering. When applied excessively, the risk is zero because it does not produce etiolation, turgidity, burns or necrosis on leaf margins. The bio-stimulator ASFAC BCO-4 (Fig.2.) can be used successfully in BIO cultures. It is easy to apply and produces no additional cost. It is compatible with herbicides or other pesticides and can be applied simultaneously, thus reducing labour costs (9).

Fig.2. ASFAC BCO-4

Fig.3. ASFAC BCO-4

Product properties: is a colourless or slightly coloured, limpid liquid, the basic composition is made up of chlorine, potassium amidosulfonyl-fenoxyacetateenriched with microelements and additives; it is non-toxic, biodegradable; the freezing temperature is -5 Celsius degrees; it has 2-year stability in sealed containers at ambient temperature(9). Regarding the mode of action, the bio-stimulator is systemic, entering the plant structure and favouring thus the growth of the chlorophyll content. It also has a positive effect on seed germination and on plant physiological processes, thereby increasing resistance and production (9). The bio-stimulator is used during growing periods by extraradicular spraying. The optimum concentration is 1 litre of solution per hectare. To spray a hectare of crop, 1 l of bio-stimulator solution is dissolved into 300-600 l of water, depending on the volume and stage of the culture. ASFAC BCO-4 is more effective when spraying is fine and applied on both sides of the leaves with a greater insistence on the lower surface where absorption is more intense. It is recommended to avoid the application of the biostimulator in case of very high temperatures because plants can go dormant and absorption is limited or discontinued (9). Using the ASFAC BCO-4 bio-stimulator (Fig. 3) leads to spectacular growth of agricultural production based on the degree of fertilization, irrigation and soil maintenance. For high increases it is important to apply balanced fertilization, which can be achieved concomitantly with the application of herbicides to the cultivated areas (9, 20).

The product is non-toxic and compatible with most chemicals used in farming, being permitted their simultaneous application. Regarding hygiene measures, it is recommended to avoid product contact with eyes, skin or ingestion (9).

MATERIAL AND METHODS

The treatment with ASFAC BCO-4 was carried out in two stages: the phenophase of the beginning of flowering (April 25th, 2013) and petal shedding (May 3rd, 2013). The harvesting of apples was conducted in early October 2013 and the measurements began on October 10th. The measurements were carried out in compliance with the specific research methods (3, 7, 10, and 13). The comparative analysis was performed on biometric measurements of the apple fruits from the varieties Jonathan, Idared and Golden Delicious treated and untreated with ASFAC BCO-4. The biometric measurements were conducted using the electronic callipers and fruit weight was measured with the Sartorius technical scales. The studied varieties were Jonathan, Idared and Golden Delicious. The dry matter was determined by refractometry based on different refraction of light in media with different densities. There was established an average sample representative of each variety.

To determine the pulp density, medium samples of 5 kg of apples were taken from each variety, from the outer and middle part of the crown. There were weighed 20 fruits, thus determining the average fruit weight. Fruits were immersed in water, measuring the volume of water displacement (cm3). By relating fruit weight and water volume there was calculated the apple pulp density (1, 2).

RESULTS AND DISCUSSIONS

Biometric measurements of apple fruits, the Jonathan, Idaredand Golden delicious varieties, treated and untreated with ASFAC BCO-4

The fruit height at the Idared variety in untreated conditions recorded the lowest value (55.07 mm) and at the Golden delicious variety the highest value (59.31 mm). With treatment, the lowest fruit height values were obtained at the variety Jonathan (57.28mm) and the highest values at the variety Idared (63.19 mm) (Table 1). Fruit diameter, without treatment, registered values ranging from 70.5 mm at Jonathan to 72 mm at Golden Delicious. With treatment, the Jonathan variety recorded the lowest value, 71.66 mm, while the Idared variety recorded the highest value, 78.33 mm.

Table 1. Measurements of apple fruits, the Jonathan, Idared and Golden Delicious varieties: fruit height (H), diameter (D) and growth rate (%), with and without treatment with ASFAC BCO-4, August-September 2013, Bacău

Varieties	Parameters	Untreated (mm)	Treated (mm)	Growth rate %
Jonathan	Height	57,14	57,28	100,245
	Diameter	70,5	71,66	101,645
Idared	Height	55,07	63,19	114,744
	Diameter	71	78,33	110,323
Golden delicious	Height	59,31	61,76	104.130
	Diameter	72	74,33	103,236

For all the studied varieties there were recorded increased values of fruit height and diameter with applied treatment compared to absence of treatment (Fig. 4). The smallest growth percentage was recorded at the Jonathan variety (0.245% in height and 1.645% in diameter). The Idared variety reacted best, recording growth under treatment of 14.744% in fruit height and 10.323% in fruit diameter. By applying ASFAC BCO-4, there was recorded, in the first year of treatment, growth at the fruits of the three studied varieties. This influences production quality and quantity.

Fig. 4. Local products treated with ASFAC BCO-4

The fruit stem reacted differently under treatment conditions. At the Jonathan variety, the stem grew (23.64 mm) under treatment compared to the value recorded under absence of treatment (19.63%) (Table 2). At the other varieties, Golden Delicious and Idared, there was a fall in stem length.

Table 2. Measurements of fruit stems for the Idared, Jonathan and Golden delicious varieties, with and without treatment with ASFAC BCO-4, August-September 2013, Bacau

Varieties	Untreated (mm)	Treated (mm)	Increase or decrease percentage (%)
Jonathan	19,63	23,64	120,427
Idared	34,03	33,15	97,414
Golden delicious	36,47	36,46	99,972

The treated Jonathan variety recorded the highest growth percentage for stems (20.427%), while the reaction of the other varieties, Golden Delicious and Idared (Figure 5) was a decrease under treatment conditions. It is a phenomenon that needs further study.

Fig. 5. Apple – the Idared variety

Comparative analysis of bioproductivity indicators for apple fruits from the Idared, Jonathan and Golden delicious varieties following treatment with ASFAC BCO-4.

The average fruit weight was determined through the research methodology of V. Cociuet al. (1, 2). Without treatment, fruit weight ranged between122.7 g (Jonathan) and 140.81 g (Golden Delicious), and at the treated trees there was an increase in fruit weight for all the varieties. The Jonathan variety recorded 127.23 g, Golden Delicious 140.98 g and Idared166.6 g (Table 3). In the 2013 crop year, the untreated plantation yielded an average production of 25t / ha with a good fructification (many fruits of smaller size).

Table 3. Measurements of fruit weight at the Jonathan, Idared and Golden Delicious varieties, treated and untreated with ASFAC BCO-4, August-September 2013, Bacau

Varieties	Parameters	Untreated g	Treated g	Growth rate %
Jonathan	Fruit weight	122,7	127,23	103,691
Idared	Fruit weight	126,39	166,6	131,814
Golden delicious	Fruit weight	140,81	140,98	100,120

By treatment with ASFAC BCO-4 the number of fruits was maintained, with an increase in fruit weight, therefore increasing production. Since fruit bud differentiation occurs the year before, in our situation, we can say that in 2012 the product acted only on already differentiated fruit buds for the 2013production. To establish the exact influence of the product ASFAC BCO-4 on the fruit production indicator it is necessary to extend the study over several crop years.

Fig. 6. Local products presentation

The Idared variety stands out with the highest percentage of fruit growth (131.814%), thus influencing fruit quality and quantity. In order to validate these results, further research is required. The Golden delicious variety recorded the lowest growth percentage (100.120%) and Jonathan recorded 103.691%. There is a differentiated response of the studied varieties (Figure 6).
Pulp density, according to the recorded data (Table 4) revealed a differentiated reaction of the studied varieties. The treated Idared variety recorded increased density value from 0.7692 cm3 to 0.8750 cm3.

The other varieties recorded, without treatment, higher densities compared to the treated varieties.

Table 4. Measurements of pulp density for apple fruits from the Idared, Jonathan and Golden delicious varieties, treated and untreated with ASFAC BCO-4, August-September 2013, Bacau

Varieties	Density untreated (cm^3)	Density treated (cm^3)	Increase or decrease percentage %
Jonathan	0,7755	0,7600	98,001
Idared	0,7692	0,8750	113,754
Golden Delicious	0,8333	0,7407	88,887

Analysis of phytochemical indicators for fruits from the Jonathan, Idared and Golden Delicious varieties untreated and treated with ASFAC BCO-4

The dry matter content, under conditions of treatment, recorded the highest growth percentage at the Golden Delicious variety (14,58%) and the lowest percentage at Idared 13.03% (Table 5).
The sugar content recorded higher values when treated with ASFAC BCO-4 compared to absence of treatment. There may be observed a correlation between the dry matter content and the sugar content. The Golden Delicious variety (Table 5) recorded 12.6%, Jonathan 11.38% and Idared 11.11%degrees Brix.

Table 5. Measurements of dry matter (Dm) and sugar content (Brix %) for the apple varieties untreated and treated withASFAC BCO-4, August-September 2013, Bacau

Varieties	Parameters (%)	Untreated (g)	Treated (g)	Growth rate %
Jonathan	Dry matter	13,3	13,35	100,375
	Sugar content	11,23	11,38	101,335
Idared	Dry matter	12,01	13,03	108,492
	Sugar content	10,4	11,11	106,730
Golden Delicious	Dry matter	12,51	14,58	116,546
	Sugar content	10,58	12,6	119,092

The growth percentage under treatment with ASFAC BCO-4 is regarded as relevant for the Golden delicious variety, both for the dry matter content (116.546%) and sugar content (119.092%). The other varieties showed lower values, which highlights the differentiated reaction of the varieties to treatment.

Measuring the content of leaves from the Jonathan, Idared and Golden Delicious varieties in terms of assimilating pigments, chlorophyll a, chlorophyll b and carotenoids, with and without treatment with ASFAC BCO-4
Chlorophyll a recorded, without treatment, percentages ranging between 0.793 mg / g (Idared) and 0.859 mg / g (Golden Delicious) (Table 6).

Table 6. Measurements of assimilating pigments for the leaves from the Jonathan, Idared and Golden delicious varieties, treated and untreated with ASFAC BCO-4, August-September, Bacau

Variety	The studied parameters	Untreated	Treated	Increase or decrease %
Jonathan	Chlorophyll a	0,782	0,806	102,432
	Chlorophyll b	0,813	0,821	100,985
	Carotenoid pigments	0,0002	0,0002	100
Idared	Chlorophyll a	0,794	0,805	101,513
	Chlorophyll b	0,827	0,992	120,193
	Carotenoid pigments	0,0002	0,0002	100
Golden Delicious	Chlorophyll a	0,859	0,975	113,506
	Chlorophyll b	0,8	0,826	103,105
	Carotenoid pigments	0,0002	0,0002	100

With treatment, the highest content of chlorophyll a was recorded at the Golden Delicious variety (0.975 mg / g) and the lowest at the Idared variety (0.805 mg / g).

Chlorophyll b showed a significant increase at the Idared variety, of 0.994 mg / g, with treatment applied. Golden Delicious and Jonathan showed values of 0.821 mg / g, respectively 0.825 mg / g.

The carotenoid pigments recorded the value of 0.0002 mg / g at all the studied varieties, which shows that no changes occurredunder treatment.

It was found an increase in the chlorophyll a and chlorophyll b content under conditions of treatment at all the studied varieties, with different percentages, confirming, for this parameter, a differentiated reaction of each variety to ASFAC BC-04.

The product ASFAC BCO-4 stimulated the formation of chlorophyll pigments in varying percentages in each variety. This influences the leaves' absorption capacity of light radiations, stimulating the photosynthesis process, with all the resulting effects. The presented results require further research.

CONCLUSIONS

Under treatment conditions, there was found relevant increase of fruit growth parameters, respectively fruit height, large and small diameter, at all the studied varieties.

The bioproductive parameters (fruit weight and pulp) recorded very relevant growth percentages.

The phytochemical indicators, namely dry matter and sugar content recorded significant increases with treatment while the acidity decreased, depending on the variety.

A characteristic of all the studied varieties is increased chlorophyll a and chlorophyll b content, which consequently influences increased absorption of light and enhances photosynthesis, with direct consequences on the biochemical content of fruits and their quality. There were found, at the studied apple varieties, under treatment conditions, different responses to treatment, depending on the variety. Fruit cracking was reduced at vulnerable varieties, there was better colouring of red fruits and fruits remained longer on the tree during the growing season.

Fruit bud differentiation at trees occurs year before production. In our case, the product acted only on already differentiated fruit buds. To determine the exact product influence on crop yield the study needs to cover several years. To confirm the results, further research needs to cover a period of at least 3 years.

ABSTRACT

Increased fruit consumption urges manufacturers to develop effective techniques to improve production. Moreover, a major market demand is ecological fruits, leading to the emergence of a large number of organic fertilizers. The aim of this paper is to demonstrate the superior quality of the ASFAC BCO-4 organic fertilizer, regarding biometric measurements of fruits, bio-indicators and phytochemical indicators. Thus, the action of this fertilizer was highlighted for three apple varieties: Jonathan, Idared and Golden Delicious. The treatment with the ASFAC BCO-4 fertilizer was applied at two important stages of the growing season: beginning of flowering phenophase and petal shedding phenophase. A first observation was a major increase of the yield for the fruits obtained after the treatment. Also, important growth increase were observed for bio-parameters. Another important result observed for all the studied varieties was the increase of chlorophyll *a* and *b* content, leading to an intensification of the photosynthesis process.

REFERENCES

1. COCIU V., OPREA ŞT., 1989 - Metode de cercetare în ameliorarea plantelor pomicole, Editura Dacia.Cluj-Napoca;
2. COCIU V., 1990 - Soiuri noi - factor de progres în pomicultură, Editura Ceres,Bucureşti;
3. CONSTANTINESCU N., 1967 - Pomicultură volumul II, Editura Agrosilvică, Bucureşti;
4. DEACONU I., MATEESCU FLORIN, 1996 – Pomii fructiferi: lucrările de înfiinţare şi întreţinere a plantaţiilor, Editura MAST, Bucureşti;
5. DROBOTĂ M., 1997 - Soiuri de pomi, arbuşti fructiferi şi portaltoi, Curslito, U.A.M.V. Iaşi;
6. GHENEA N. şicolab, 1977 – Pomicultura generală şi specială, Editura Didactică şi Pedagogică, Bucureşti;
7. GRĂDINARIU G., ISTRATE M., 2004 – Pomicultură generala si specială, Editura Moldova, Iaşi;
8. HORNUNG STEFAN, 1975 - Cerinte fata de sol in pomicultura; Editura Ceres, Bucureşti;
9. ION LIGIA, 2007 - Pomicultura, Editura Ceres, Bucuresti;
10. MIHAESCU GR., 1982 - Cultura pomilor pe langa casa, Editura Ceres, Bucuresti;
11. MIHĂESCU GRIGORE, 2007 - Pomicultura de la A/Z : Enciclopedie,Editura ASAB, Bucureşti;
12. MILICĂ C.I. ŞI AL., 1982 – Fiziologie vegetală, Editura Didactică şi Pedagogică, Bucureşti, p. 101;
13. NEGRILĂ A.**,** 1971 - Pomicultura, Editura Didactică şi Pedagogică, Bucureşti;
14. PANTEA S. D., 2012, - Efectul diferitelor sisteme de lucrare a solului asupra calităţii şi cantităţii producţiei la mărul cultivat în sistem superintensiv, rezumat al tezei de doctorat, Cluj-Napoca;

15. POP E., PETERFI ŞT., 1964 - Fiziologia plantelor, Bucureşti, p. 101;
16. POPESCU M., MILITIU I., MIHĂIESCU GR., CIREAŞĂ V., GODEANU 1., CEPOIU N., DROBOTA GH., 1982 – Pomicultura general şi specială., Editura EDP, Bucureşti;
17. RAŢI IOAN VIOREL, 2001 - Mărul, pasiune şi afacere, Editura Moldavia, Bacău;
18. RAŢI IOAN VIOREL, 1995 - Cercetări privind sortimentul de măr pentru Podişul Central al Moldovei - Teză de doctorat, ASAS, Bucureşti;
19. ROŞCA IOAN, IACOMI BEATRICE, DOBRIN IONELA, TUDOSE MINODORA, ISTRATE RADA, VLAD FULVIA FLORICa, 2008 - Recomandări de combatere integrată a bolilor si dăunătorilor din pomicultură-Ghid pentru fermieri-Proiectarea şi implementarea unui sistem de management durabil al agroecosistemelor pomicole pe baza evaluării cu modele numerice şi tehnici satelitare a impactului schimbărilor climatice (POMOSAT), Editura Invel Multimedia;
20. SONEA VASILE, ANTON LIACU şi MARIUS POPESCU, 1968 - Pomicultura, Editura Didactică şi Pedagogică, Bucureşti;
21. TEACI DUMITRU, PUIU ŞTEFAN, AMZĂR GHEORGHE, 1985 – Influența condițiilor de mediu asupra creşterii pomilor în România (Ecometrie pomicolă), Editura Ceres, Bucureşti;

***http://www.fertilizator.ro/datacenter/asfac/fisa%20tehnica.pdf.

AUTHORS' ADDRESS

ANDREI SIMONA - Doctoral School of Vasile Alecsandri University of Bacau, Calea Marasesti 157, 600115, Bacau, Romania, simonaa_andrei@yahoo.com;

RAŢI IOAN-VIOREL, RĂDUCANU DUMITRA, BĂDĂLUȚĂ NICOLETA - Department of Biology, Ecology and Environmental Protection, Vasile Alecsandri University of Bacau, Marasesti 157, Bacau, 600115, Romania, e-mail: ratiioanviorel@yahoo.com; dumitra_manea@yahoo.com; nicoletadogaru@yahoo.com.