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RESPONSE OF POTTED RASPBERRIES AND BLACKBERRY VARIETIES TO ORGANIC TECHNOLOGY MEASURES IN HIGH TUNNEL SYSTEM

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Abstract

Nowadays, raspberry and blackberry are one of the most desired fruits for fresh consumption even beyond the ripening season. To meet the market need and support farmers with new growing solutions and organic measures applied in the orchards, in early 2019, we set out couple of experiments to demonstrate the viability of such innovative crop systems. Two new raspberry varieties 'Polonez' and 'Poemat' and one blackberry variety 'Navaho' were subject of pot system in high tunnel protected area with Nectarine plastic film. Substrates were composed by different share of organic peat, Biohumus and mycorrhiza. In each pot of 20 litres volume were planted two root cubes and a trellis system was provided. A mix of organic fertilizers were applied during the vegetation period and the plants response was evaluated in terms of growth and fruiting capacity. By the end of the year, 'Poemat' was picked for 5 times and 'Polonez' for one time more. No fruits available at 'Navaho' in the first year. The total number of harvested fruits were higher at 'Polonez' but the size was lower comparative to 'Poemat'. Longer canes were measured at 'Polonez' but 'Poemat' assembled more growths in terms of total annual growths due to a better ramification can. The Biohumus positively affect the growths of the plants independent of the fertilization scheme.

Key words*: Rubus idaeus, primocane, Rubus fruticosus, substrates, organic, fertilizers.*

INTRODUCTION

The demand for organic berry fruits is worldwide increasing and the profitability is higher by extending the harvest out of regular season (Rom et al., 2010).

More research is conducted to control on command the flowering and fruiting in berry crops (Strik, 2012) manipulating the crop for year-round production.

Raspberry performance in tunnels is well known (Demchak, K., 2009) and is more productive than in the open field and the fruits are bigger (Wien and Pritts, 2009).

In the northern countries raspberries cultivation under the plastic is the only way to achieve profitable yields due to the climate constraints (Svensson, 2016). Even for the blackberry in the cold regions (Hanson, 2012).

One solution to boost cane growth, flowering and fruiting before fall frost is to cover the row early in the Spring and unveil later on or to use high tunnels (Lewandowski et al., 2015).

Another approach is to protect plants from frost in the months of the year while canes are still late fruiting in order to extend the harvest as much as possible (Oliviera et al. 1996).

Raspberry pot culture in high tunnels can yield better than in-ground soil production (Qiu et al., 2016). Cultivating in pots, we can manage the timing of fruit production by keeping plants in cold storage until the desired production time similar with strawberries (Pritts, 2008). Another big advantage of using berry pot culture is that we can avoid the soil borne diseases and pathogens and control efficiently the risk of spreading the infection (Asanica, 2019).

Shorter canes are subject to less productive floricanes (Hanson et al., 2019) but primocane-fruiting varieties can be grown for several years in pots with great success.

In organic system, several key diseases, pests and disorders are in the eye of the researchers. Duringthe vegetation season, plants are frequently attacked by aphids. Therefore, beside common methods to fight against insects in ecological manner is the breeding method (Dossett and Kempler, 2016).

In the modern culture, raspberries easily adapt to fertirigation and substrate growing conditions (Qiu et al., 2017) but the regime and the

technological measures are subject to more conducted research in this topic.
The aim of the present work is to find the optimum way for growing organic raspberries and blackberry varieties in an appropriate and suitable technological manner for controlled climate and growing conditions starting from substrate composition till the fertigation application scheme. The adaptation in such growing system of some brand-new Polish raspberry varieties is a subgoal of the current research.

MATERIALS AND METHODS

The experiment was established in 22nd of April, 2019 and designed as follows:
Size of the solar: 6 m x 18 m.
Solar cover: Ginegar Suncover Nectarin of 150µ (87% light transmission, 35% light diffusion, 85% termicity); UV trans 300-380 nm - 45%.
Biological material: two raspberry varieties ('Polonez' and 'Poemat') and one blackberry variety ('Navaho').
Growing pots (containers): 20 litres.
Growing substrate: different share of organic peat Kekkila OPM525 and biohumus.
Mulch: Agrotextile under the pots.
Irrigation: drip line with stakes emitters of 6 LPH (2 stakes/pot)/
Nutrition: organic fertilizers (New Logic, Bioact Veg for soil application; Lumbreco for foliar and substrate application); mycorrhiza Glomus (Aegys Sym) and Trianum-V (Koppert) in pot only at the planting time.
Fertilizers were applied regularly starting from the planting day (22nd of April) with mycorrhiza (1 cup/pot) in the upper part of the substrate and Trianum-V 1 g/10 plants (23rd of April, 2019) by watering.
New Logic (0.6%) has been applied three times on substrate (3rd of May, 29th of May and 5th of August) in a dose of 3 ml/pot/application.
Bioact Veg has been used eight times to fertilize the plants on substrate with 3ml/pot/application (11th of May, 28th of May, 13rd of June, 29th of June, 18th of July, 25th of July, 13rd of August, 16th of September).
Lumbreco (2%) was used to fertilize by five times the substrate of the pots with 10 ml/pot/application on the following dates: 25th of April, 3rd of June, 11th of July, 23th of July, 26th of August). Other five application were made with Lumbreco (0.6%) by spraying on leaves with 0.33 ml/plant/application (6th of May, 20th of June, 15th of July, 22nd of August, 9th of September).
The experimental scheme is presented for the raspberry and the blackberry in the Table 1 and the module design in the Figure 1.

Table 1. Experimental variants constituted by location, substrate mixture and fertilization scheme application

Variant	Type	Substrate	Foliar fertilization	Substrate fertilization
V1	solar	peat 100%	Lumbreco	New Logic
V2	solar	peat 100%	-	Bioact Veg + Lumbreco
V3	solar	peat 75% + Biohumus 25%	Lumbreco	New Logic
V4	solar	peat 75% + Biohumus 25%	-	Bioact Veg + Lumbreco
V5	solar	peat 50% + Biohumus 50%	Lumbreco	New Logic
V6	solar	peat 50% + Biohumus 50%	-	Bioact Veg + Lumbreco
V7	solar	peat 75% + Biohumus 25% & mycorrhiza	Lumbreco	New Logic
V8	solar	peat 75% + Biohumus 25% & mycorrhiza	-	Bioact Veg + Lumbreco
V9	solar	peat 100% & mycorrhiza	Lumbreco	New Logic
V10	solar	peat 100% & mycorrhiza	-	Bioact Veg + Lumbreco
V11	open field	peat 75% + Biohumus 25% & mycorrhiza	Lumbreco	New Logic
V12	open field	peat 75% + Biohumus 25% & mycorrhiza	-	Bioact Veg + Lumbreco
V13	open field	peat 100% & mycorrhiza	Lumbreco	New Logic
V14	open field	peat 100% & mycorrhiza	-	Bioact Veg + Lumbreco

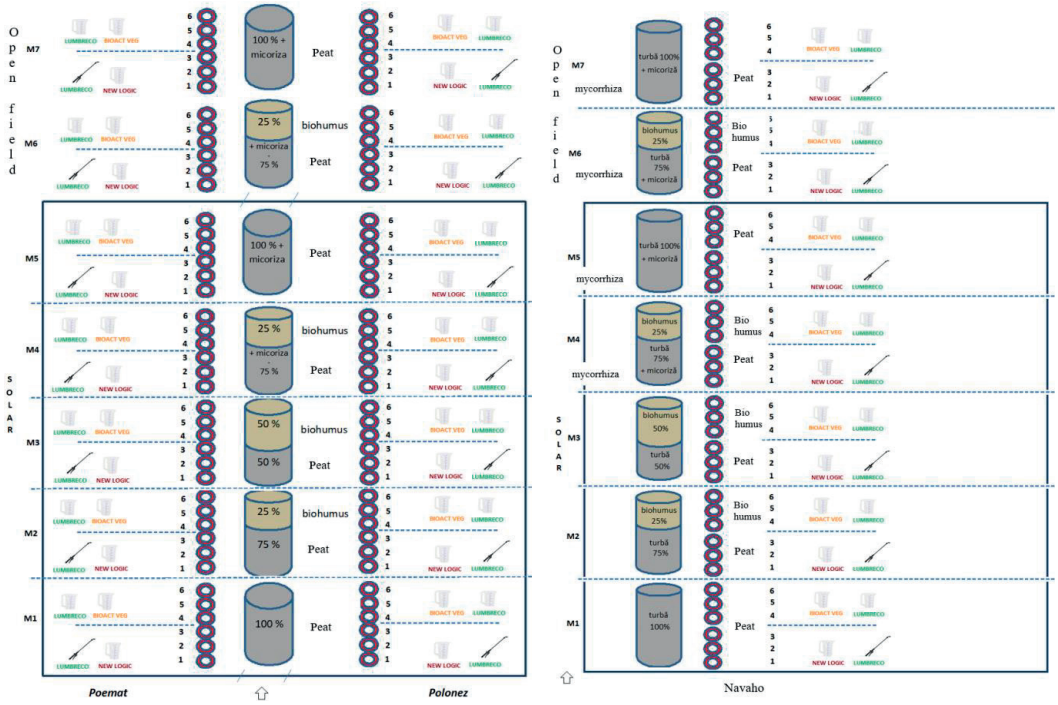

Figure 1. Experimental model for raspberry and blackberry fertilization

RESULTS AND DISCUSSIONS

The experiments started in 22th of April, 2019 and first organic products were applied. For instance, Trianum-V (1 g/10 plants) and 1 cup of Aegys mycorrhiza were distributed.

For raspberries we remarked wide differences regarding the height of the canes. The variants with the Bioact Veg and Lumbreco applied in the substrate increased the growths comparing to New Logic applied in substrate and with foliar Lumbreco sprays.

The average values independent of the other experimental factors indicate a higher vigour with 8% of 'Polonez' than 'Poemat' translated in height of the plants (Figures 2 and 3).

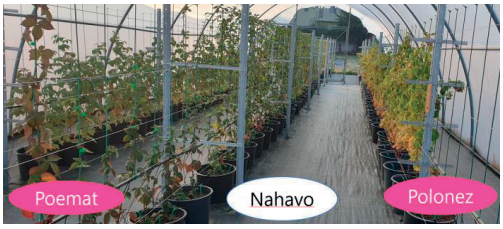

Figure 2. Evolution of raspberry and blackberry plant growths in relation with variety and fertilization scheme applied (October, 2019)

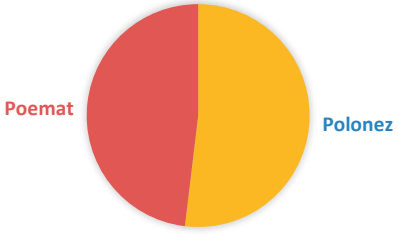

Figure 3. Vigour of raspberry varieties

One big difference between the two raspberry varieties is the ramification capacity. 'Poemat' is more spreading than 'Polonez' and exceed the 'Poemat' growths in terms of total annual growths / plant. From this point of view, the growing potential of 'Poemat' is in average with 38.63% higher than 'Polonez'.

Presence of biohumus in the substrate highly influenced the plants development regardless the variety features and the fertilization scheme (Figure 4).

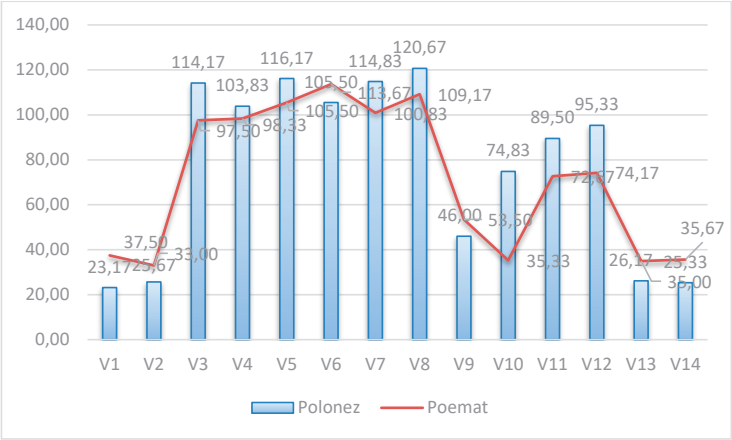

Figure 4 Influence of biohumus in the total height of the raspberries canes (cm)

The cumulative factors effect upon the height of the blackberry canes shows at the end of the growing season a large variation in these biometric values. Thus, the lowest plants were ones planted in the substrate containing only organic peat (65 cm) while the variants with biohumus added in different shares increased the total annual growth sum. The blackberry canes exceed 300 cm in height (Figure 5).

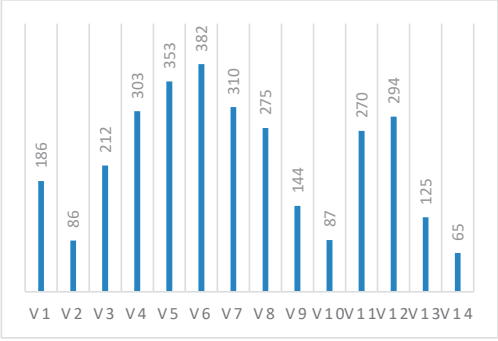

Figure 5. Fertilization scheme and substrate composition influence on 'Navaho' blackberry height

Regarding the blackberry fertilization scheme, the differences found were not significantly higher but a slight positive influence on plant growth was noted when applying the New Logic product in combination with leaf Lumbreco application (plants grew on average 228.57 cm) compared to BioactVeg with radicular Lumbreco application (213.14 cm).

First year for blackberry did not bring fruits on lateral shoots but for both raspberry varieties the production was quite good, proving the precocity of the Polish cultivars.

'Polonez' remarked with a higher yield. In average, it was picked 105 fruits/plant comparing to 23 fruits/plant at 'Poemat'.

The harvest period was marked by seven picks with the following dates: 20th of August, 30th of August, 20th of September, 27th of September, 3rd of October, 15th of October and 23rd of October.

Counting the number of fruits harvested at 'Poemat' (4617 fruits) and relating them to the yield (4.62 kg) results in an average weight of a fruit of 2.4 g. The Polish variety surpassed the sister variety with a number of fruits harvested in 2019 of 7848 pics, respectively 7.85 kg, but the size of the fruit was slightly smaller, of about 2.0 g (Figure 6).

The number of raspberry fruits were directly influenced by the substrate composition and fertilization model (Table 2).

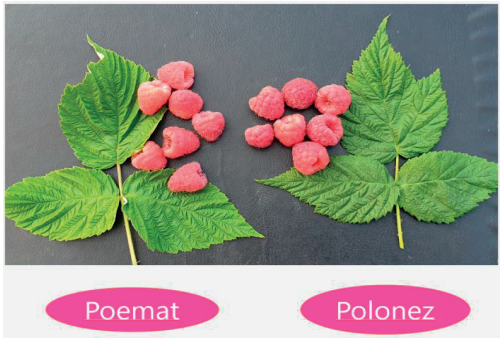

Figure 6. Size and appearance of the Polish raspberry varieties

Table 2. Number of fruits picked in the first year of raspberries planting under the influence of different fertilization schemes and substate composition

Variant	Type	Substrate composition	Application method of the fertilizer		No of fruits	
			Foliar	Substrate	'Polonez'	'Poemat'
V1	solar	peat 100%	Lumbreco	New Logic	0.00	0.00
V2	solar	peat 100%	-	Bioact Veg + Lumbreco	0.00	1.00
V3	solar	peat 75% + Biohumus 25%	Lumbreco	New Logic	195.83	44.00
V4	solar	peat 75% + Biohumus 25%	-	Bioact Veg + Lumbreco	203.83	59.83
V5	solar	peat 50% + Biohumus 50%	Lumbreco	New Logic	223.00	47.00
V6	solar	peat 50% + Biohumus 50%	-	Bioact Veg + Lumbreco	227.00	26.00
V7	solar	peat 75% + Biohumus 25% & mycorrhiza	Lumbreco	New Logic	231.00	48.83
V8	solar	peat 75% + Biohumus 25% & mycorrhiza	-	Bioact Veg + Lumbreco	260.83	71.67
V9	solar	peat 100% & mycorrhiza	Lumbreco	New Logic	33.17	3.50
V10	solar	peat 100% & mycorrhiza	-	Bioact Veg + Lumbreco	44.50	4.67
V11	open field	peat 75% + Biohumus 25% & mycorrhiza	Lumbreco	New Logic	24.33	9.50
V12	open field	peat 75% + Biohumus 25% & mycorrhiza	-	Bioact Veg + Lumbreco	29.00	9.50
V13	open field	peat 100% & mycorrhiza	Lumbreco	New Logic	0.00	0.67
V14	open field	peat 100% & mycorrhiza	-	Bioact Veg + Lumbreco	0.00	0.50
Average					*105.18*	*23.33*

The highest number of fruits picked at 'Polonez' was on 15th of October (Figures 7 and 9) while the pick of the harvest at 'Poemat' was 30th of August (Figure 7).

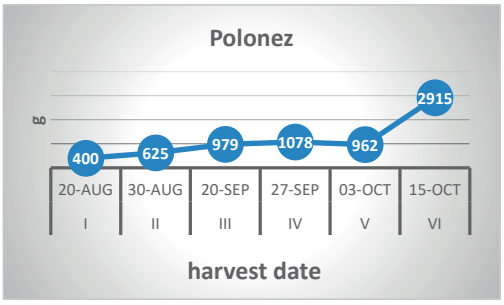

Figure 7. Dynamic of harvest at 'Polonez' variety

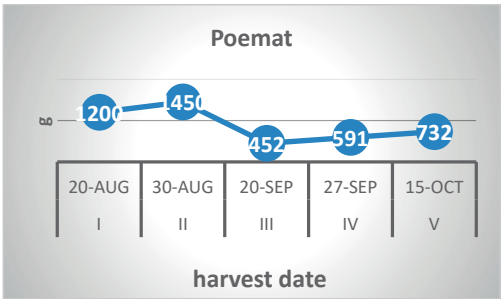

Figure 8. Dynamic of harvest at 'Poemat' variety

Figure 9. Late ripening of the 'Polonez' fruits (15.10.2019)

The mycorrhization of the substrate in some variants did not showed an improvement for fructification, neither for growths but the effect should be investigated on longer term.

Lumbreco with Bioact Veg were more efficient in raspberry productivity when it was applied directly in substrate with about 9% increase of production than fertilization scheme based on New Logic in soil and foliar Lumbreco.

During the growing season, inside and in open field plants were affected by aphids which has been controlled efficiently with Laser and Chrysopa Koppert natural predators.

CONCLUSIONS

Longer canes were measured at 'Polonez' but 'Poemat' summed more growths in terms of total annual growths due to a better ramification can.
The total number of harvested fruits were higher at 'Polonez' but the size was lower comparative to 'Poemat'.
The harvest pick at 'Poemat' is in the end of August while at 'Polonez' is in late Autumn.
Biohumus positively affect the growths of the plants independent of the fertilization scheme.
New Logic product in combination with leaf Lumbreco application had a good influence on blackberry growths. No fruits were harvested in the first year from 'Navaho'.

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