

Fertilization of apple trees with organic fertilizers “Keratin” and “Lumbreco” in Bulgaria - preliminary results

V. Dzhuvinov¹, I. Staneva¹, S. Gandev¹, H. Kutinkova¹, D. Stefanova¹, G. Kornov¹, M. Stoeva¹

Abstract

The trials were carried out at a private farm in Plovdiv region with coordinates: 42°03' N and 24°32' E and 184 m on the sea level. The apple trees were planted in March 2016 at a spacing of 3,50 x 1,25 m with cvs “Golden B” and “Granny Smith”/M 26 in a North-South row orientation. Training system is spindle, irrigation system – drip and soil management natural sod mulch interrow. For the study were used 3 trees in 8 replicates. The trunk diameter was measured in the beginning and the end of vegetation season and the foliar analysis - in the beginning of July and August.

During the season 2019 were used organic fertilizers „Keratin“ and „Lumbreco“ according BBCH stages - first treatment before BBCH 60, second - after 69 and third - one after 73 stage. The dosage of „Keratin“ was 25 kg/ha and „Lumbreco“ - one liter concentrate plus 150 liters water and from this solution 10 liter per tree.

According to Gorbanov S. (2018) the optimum value of N in apple leaves is 2.6%. Near the optimal content were data from July analysis at variant „Lumbreco“ following by „Keratin“. The optimum level of P (P₂O₅) is 0.4% and more of this level is for „Keratin“ only. For other macro nutrient K (K₂O) the optimum content is 1.6% but the data from analysis and for variants are very variable. More than optimal level - 0.4% of Mg were in Keratin variant and for Ca optimum - 1.5% for Lumbreco. All these data demonstrated that Keratin and Lumbreco are suitable for organic fertilizers in apple orchards.

Keywords: fertilization, organic fertilizers, „Keratin“, „Lumbreco“, apple orchard

Introduction

Organic farming is a form of agriculture which excludes the use of synthetic fertilizers and pesticides, plant growth regulators and livestock feed additives (Adetunji,2012). Fertilizers and soil conditioners made from animal bone tissues could be used as slow-release nitrogen fertilizers. In slow-release nitrogen fertilizers nutrient are gradually released therefore decreasing the extent of leaching and improving efficiency of nitrogen usage (Zabitis et al.,2012). Fertilizers, especially nitrogen ones, are one of the means in solving problems of supplying inhabitants with food. However, ineffective use of nitrogen fertilizers may cause nitrates leach into ground water and pollute rivers as well as other water clusters (Jensen et al., 2003).

¹ Fruit Growing Institute, “Ostromila” 12, 4004 Plovdiv, Bulgaria; vcd@valan.net

Objectives

Influence of organic fertilizers “Keratin” and “Lumbreco” on vegetative and reproductive behaviours on apple trees.

Material and Methods

The experimental apple orchard is located 26 km South West of Plovdiv and 184 m on the sea level. It is established in March 2016 on sandy fluvisols with apple cvs "Golden B" and "Granny Smith" on M26 rootstock and spacing 3.50 x 1.25 m. Training system is spindle, irrigation - drip and soil management - natural sod mulch. For each treatment were used 3 trees in 8 replicates. The trunk diameter was measured at 20 cm above the soil in the beginning and the end of vegetation season. Soil analysis: before beginning of vegetation season – in depth 0-15 cm and 15-30 cm for macro and micro nutrients. The main mass of apple roots according Stoilov (1977) are between 10 and 60 cm depth. Foliar analysis was made in July and August, when the vegetative growing is finished.

The fertilization were used according BBCH stages - stage 53 and 75 with liquid “Lumbreco” origin from red Californian worm (*Lumbricus rubella*) - Lumbreko EOOD, Plovdiv, Bulgaria - one liter concentrate + 150 liters water. It was used 10 liters solution per tree and “Keratin” (horn grit) - Beckmann & Brehm GmbH (Germany)- 25 kg/ha.

The season during 2019 was very dry – in April, May, August and September the precipitations were less than 5 mm per month. The RH in August were 60% and about 70% for April, May and July and mean temperature for April, May, June, July and September – near 20°C (Fig.1).

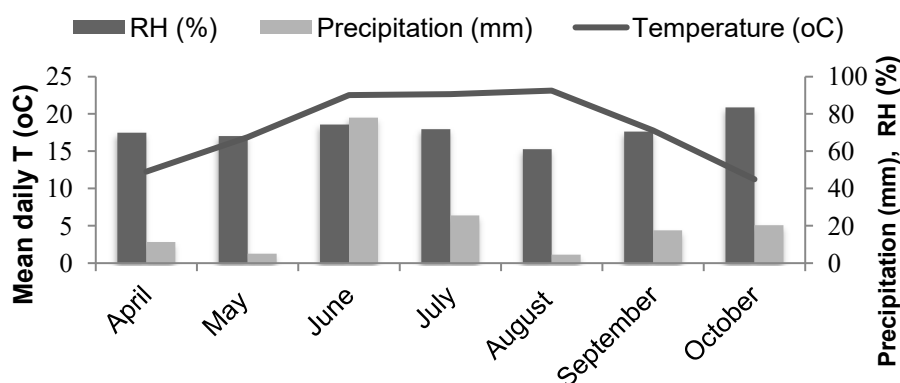


Figure 1. Meteorological data for 2019

Results and Discussion

For the variant of “Keratin” for depth 0-15 cm the value of NH_4 is 56.38 mg/kg and 42.28 mg/kg and for “Lumbreco”, and for 15-30 cm - 45.30 mg/kg and 46.31 mg/kg respectively. The data show that content of NH_4 for “Keratin” variant is higher than variant of “Lumbreco” and it is similar for 15-30 cm depth. For NO_3 the value for variant “Keratin”, 0-15 cm is 41.28 mg/kg and 48.32 mg/kg for “Lumbreco”. For depth 15-30 cm the value is 42.28 mg/kg for “Keratin” and 27.18 mg/kg for “Lumbreco”. It is interesting that value of NO_3 for “Keratin” variant is similar for 0-15 and 15-30 cm depth, because the cattle horn are suitable for use

as slow release nitrogen fertilizer (Pekarskas et al., 2015) and content of nitrogen in the leaves decreasing since May to October – November (Gorbanov, 2018).

The content of P₂O₅ from variant “Keratin” is higher in depth 15-30 cm - 25.25 mg/kg and 13.96 mg/kg for 0-15 cm. The similar is data for “Lumbreco” for value of NH₄⁺ - 42.28 mg/kg for 0-15 cm and 46.31 mg/kg for 15-30 cm depth (Fig. 2).

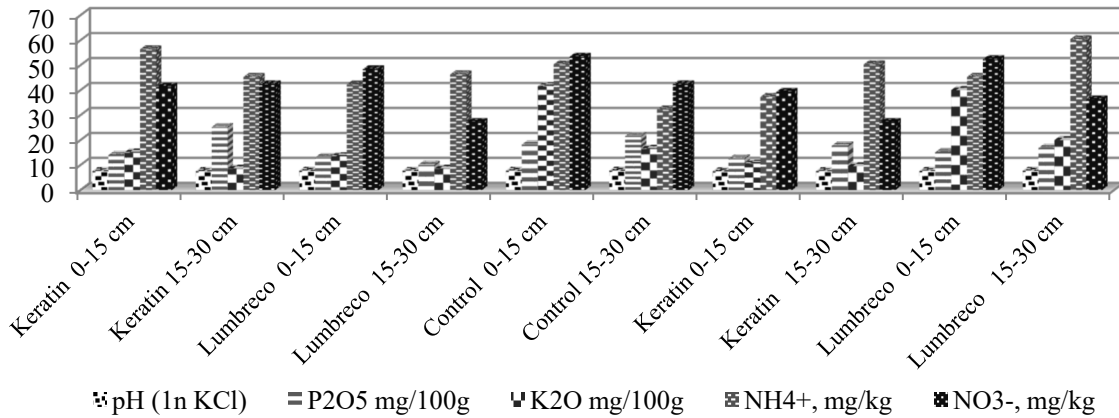


Figure 2: Soil analysis (first results)

The optimum data for leaf value of N, P, K, Mg, Ca and Fe is according Gorbanov S. (2018). The optimum content of N is less for all variants and for P is higher for all variants during July and it is less during August, because the root system of the apple plants absorbed the nutrients. The value of K is higher for variant “Lumbreco”.

- Golden B/Keratin
- ▨ Granny Smith/Keratin
- ▤ Golden B/Lumbreco
- ▧ Granny Smith/Lumbreco
- Control

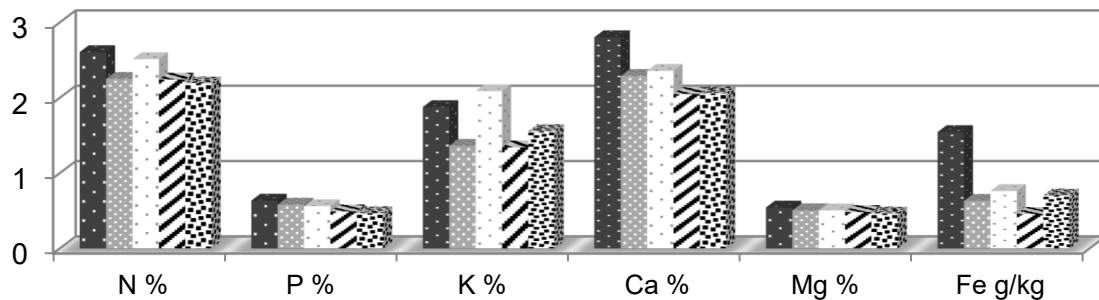


Figure 3: Leaf analysis (10.07.2019)

- Golden B/Keratin
- ▨ Granny Smith/Keratin
- ▤ Golden B/Lumbreco
- ▧ Granny Smith/Lumbreco
- Control

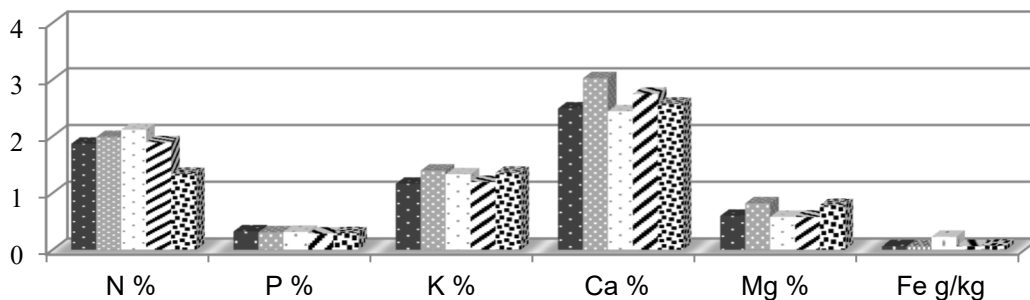


Figure 4: Leaf analysis (19.08.2019)

Bellow the optimum is for variant “Keratin” for July test. The data for August is less than optimum content for all variant. The value of Mg is highest for all variant for July and August. The content of Ca is higher than optimum level for July and August for all variant and contrary for Fe, it is less than optimum for all variant. We need to mentioned that content of total N in “Lumbreco” is 1800 mg/l and in “Keratin” as NH₄ is 19.28%, content of P is 1030 mg/l and 2.215 mg/g for “Lumbreco” and for “Keratin” respectively. The content of K is 2.03% and 2.454 mg/g for the mentioned organic fertilizers and Ca, Mg and Fe in “Lumbreco” is higher than 200 mg/l for all nutrients. The good content of Ca, K and Mg in untreated control – fig.4 we can explain with manure using during previous 2018 season. Determination of optimal picking date: by penetrometer - firmness of fruit flesh-7 kg/cm² for cv. “Golden B”, color chart of CTIFL, INRA, iodine test and soluble solids by Brix (9 of September, 2019). The optimal picking date by penetrometer is 7.5-8.0 kg/cm² for cv. “Granny Smith” plus other tests (8 October 2019).

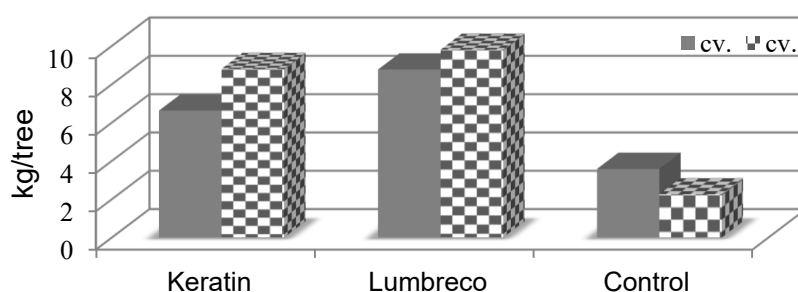


Figure: 5. Yield of fruits for cvs. “Golden B” and “Granny Smith” (kg/per tree)

For “Golden B” the yield is minimum 16.7 t/ha and maximum 19.6 t/ha and for cv. “G. Smith” is minimum 12.7 t/ha and maximum 24.8 t/ha. The yield is low because it was a frost on 29 of March (minus 3.0° C) and in the beginning of April (from minus 1.7° C to 2.0° C).

Table 1: Growth of diameter of the stem during 2019 season (mm)

cv. "Golden B"		
Keratin	Lumbreco	Control
5.32	3.66	3.69
cv. "Granny Smith"		
Keratin	Lumbreco	Control
6.97	5.31	4.67

The growth of diameter of the apple stem for “Golden B” is higher for “Keratin” variant -5.32 mm and for cv. “Granny Smith”, also – 6.97 mm. The growth of the shoots for “Golden B” is higher for “Lumbreco” variant - 26.57cm and the for “Keratin” - 24,27 cm. The growth of the shoots for „Granny Smith” is higher for variant “Keratin” 32.07 cm than for Lumbreco one - 26,67 cm. These data demonstrated that organic fertilizer “Keratin” has a beter influences on vegetative behaviors on aple cvs.”Golden B” and “Cranny Smith”.

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