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INFLUENCE OF POSITION WITHIN THE TERRACES PLATFORM ON SOME CHEMICAL COMPONENTS IN CASE OF THREE SOIL TYPES IN A HIGH DENSITY APPLE ORCHARD

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Abstract

Preparation of sloped terrain to establish fruit trees plantations on terraces built upon the classical method „Debleu-rembleu" determine an uneven disposition of the soil properties on the platforms, with negative consequences on fruit trees behaviour. In order to limit these inconvenients, at RIFG Pitesti Romania, in the year 1983 was experimented a new method for terraces building, including a more uniform way of vegetal floor disposition on the terraces platforms. The terraces were 25 m wide and the transversal declination of the platform between 9.4 - 12.3%. On each platform of the five terraces, seven rows of apple trees were planted at 3.6 m between the rows. The following bifactorial experimental scheme was set up: A factor = the soil type, with the graduations: a_1 = eutricambosoil with coluvic character; a_2 = slightly eroded eutricambosoil; a_3= typical eutricambosoil; B factor = the position on the terraces platform, with the graduations: b_1 = downstream platform, located on the interval between the tree rows 1 and 2; b_2 = middle platform located on the interval between the rows 2 and 3; b_3 = middle platform located on the interval between the rows 3 and 5; b_4 = upstream platform, located on the interval between the rows, 6 and 7. During 2011, 27 years after the fruit trees establishment, inside of each experimental treatment, in four replications and three soil depths, the humus content, mobile phosphorus, mobile potassium and pH values were analysed. In average, on the three soil types and three soil depths investigated, the values of the chemical components registered on downstream positions compared with the upstream ones were higher in the case of mobile phosphorus (64%), mobile potassium (25%), humus content (21%), but 4.4% lower in the case of the pH values. The differences registered between the two positions inside the terraces platform are much lower than the ones presented in the literature, due to the different methods used in the two situations for terraces building.

Key words: *apple, terrace, humus, phosphorus, potassium*

INTRODUCTION

The previous researches [1, 2, 3, 4, 5, 7, 8] revealed that on the terrains with a slope higher than 12% soil erosion control and provision of the conditions for mechanization of the works in the fruit trees plantations can be realised by soil preparation in terraces of different types and dimensions. The terraces building was realized using the classical method „debleu-rembleu", by soil movement from the upstream of the further platform to the downstream, until the realisation of the proper transversal declination. The terraces built in this way had some advantages but presented also the disadvantage of the uneven disposition of the surface fertile soil on their platform [8]. In order to diminish this inconvenient, starting with the year of 1983, at Colibasi farm belonging to RIFG Pitesti - Romania a new method for terraces building was experimented. In this paper, are presented the effects of this new method registered 27 years after trees establishment, on the disposition of some chemical components on three soil types and four positions delimited inside the terrace platform.

MATERIAL AND METHOD

The terraces placement was realized on a hill side with a slope up to (16%) which made the transition between the second and the third terrace of Doamnei River. In order to keep the vegetal and more fertile soil layer on the surface of the further terraces, from the surface of the first terrace proposed to be realized downstream to the hill side, the vegetal superficial soil layer, 25-30 cm thick, was gathered and pushed with the bulldozer blade in the inner part of the second terrace, situated upstream of hill side. Then, on the resulting terrain, the transversal declination of the first terrace was realized by pushing the soil on the terrace downstream. After that action, the vegetal superficial soil layer, disposed in the inner part of the second terrace, was brought back on the first terrace and distributed as uniform as possible. In the same manner, the vegetal superficial soil layer from the further second terrace was disposed in the inner part of the third terrace and so on, until the preparation of the entire hill side. The terraces had a platform of 25 m wide and the transversal declination between 9.4 and 12.3%. On each terrace platform, seven tree rows at 3.6 m between the rows and 1.5 m between the trees along the row were planted. The following experimental scheme was organized: A factor = the soil type, with the graduations: a_1 = eutricambosoil with coluvic character; a_2 = slightly eroded eutricambosoil; a_3 = typical eutricambosoil. B factor = the position on the terraces platform, with the graduations: b_1 = downstream platform, located on the interval between the tree rows 1 and 2; b_2 = middle platform located on the interval between the rows 2 and 3; b_3 = middle platform located on the interval between the rows 3 and 5; b_4 = upstream platform, located on the interval between the rows, 6 and 7. The soil samples in four replications on the depths: 0-20 cm; 20-40 cm; 40-60 cm were taken. Each sample was constituted by 5-6 sub-samples taken from the points distributed as uniform as possible inside the experimental treatments. The humus content (%), mobile phosphorus (ppm), mobile potassium (ppm) and pH values were analysed.

RESULTS AND DISCUSSIONS

Influence of soil type and the position on the terrace platform on some chemical components of the soil

Mobile phosphorus content (ppm)

On the depth 0 - 20 cm, in average of the four position delimited on the terrace platform (b_1, b_2, b_3, b_4) among the three soil types (a1, a_2, a_3), the highest value of the mobile phosphorus was registered on the slightly eroded eutricambosoil (36.058ppm). This value was distinctly significant higher 78%, compared with the value registered on the eutricambosoil with coluvic character (20.3 ppm). Under the same conditions, the value of the mobile phosphorus registered on the typical eutricambosoil (32.733 ppm) was significantly higher 61%, compared to the one registered on the eutricambosoil with coluvic character (Fig. 1).

In average, on the three soil types (a_1, a_2, a_3) the value of the mobile phosphorus registered downstream the platform b_1, was significantly higher with 15.77% compared to the values registered on the positions b_2 and b_3 and distinct significantly higher with 113.6% compared with the value registered upstream platform (b_4).

On the depth 20-40 cm, in average on the four positions delimited on the terrace platform (b_1, b_2, b_3, b_4), among the three soil types, the highest value of the mobile phosphorus content was registered on the slightly eroded euticambosoil (12.05 ppm). This value was distinct significantly higher 62%, compared to the one registered on the eutricambosoil with coluvic character (7.417 ppm) and 95.4% higher, compared to the value registered on typical eutricambosoil (6.161).

In average, on the three soil types (a_1, a_2, a_3) the value of the mobile phosphorus content registered downstream the terrace platform b_1, was distinct significantly higher with 60-68%, compared to the values registered on the positions b_2 and b_3 (Fig. 1).

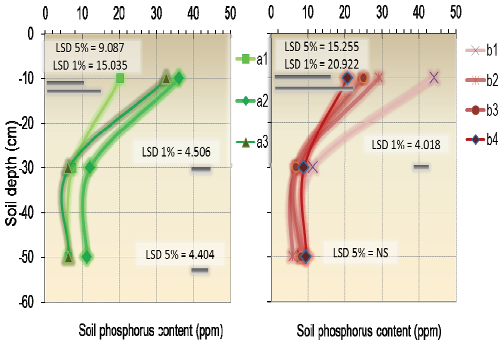

Fig. 1 Influence of soil type and of the position in the terrace platform on P content within the 3 soil depths (mean values of A/B experimental factors graduations) Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

The mobile potassium content (ppm)

On the depth 0 - 20 cm, in average on the four position delimited on the terrace platform (b_1, b_2, b_3, b_4), among the three soil types (a_1, a_2, a_3), the highest value of the mobile potassium was registered on slightly eroded eutricambosoil (287 ppm). This value was significantly higher with 50% compared to the value registered on the typical eutricambosoil (190.7 ppm).

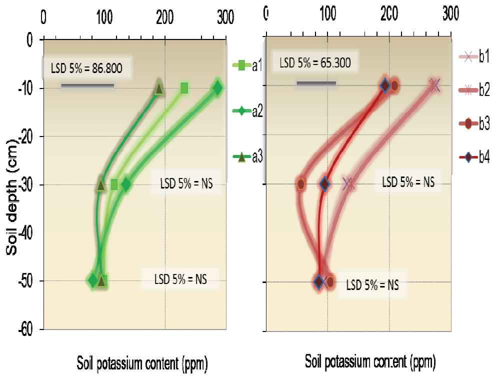

Fig. 2 Influence of soil type (a_1, a_2, a_3) and of the position in the terrace platform (b_1, b_2, b_3, b_4) on K content within the 3 soil depths (mean values of A/B experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

In average, on the three soil types (a_1, a_2, a_3) the mobile potassium content registered in position b1 from the terrace platform was significantly higher with 32.43% compared with the values registered on the positions b_3 and b_4. In addition, the value of the same chemical characteristic, registered on the position b_2 (270.0 ppm), was significantly higher with 40% compared with the one registered on the position b_4 (192.9). On the others soil depths (20-40 and 40-60 cm), the values of mobile potassium content were not significantly different among them, both on the three soil types (a_1, a_2, a_3) and on the four positions on the terrace platform (b_1, b_2, b_3, b_4) (Fig. 2).

The pH values

On the depth 0-20 cm, the pH value registered on the typical eutricambosoil (5.364) was significantly higher with 4.8% compared to the value registered on the eutricambosoil with coluvic character (5.117). On the depth 20-40 cm, in average on the three soil types (a_1, a_2, a_3) the pH value registered on b_4 position of the terrace platform was distinct significantly higher 4.1 - 4.2%, compared with the values registered on the positions b_1 and b_3, and very significantly higher 6.3% compared to the value registered on the position b_2 (4.816). On the depth 40-60 cm, in average on the three soil types (a_1, a_2, a_3), the pH value registered on the position b4 of the terrace platform (5.294) was very significantly higher with 6.7 - 8.5%, compared to the values registered on the positions b_1, b_2 ,b_3, Fig. 3.

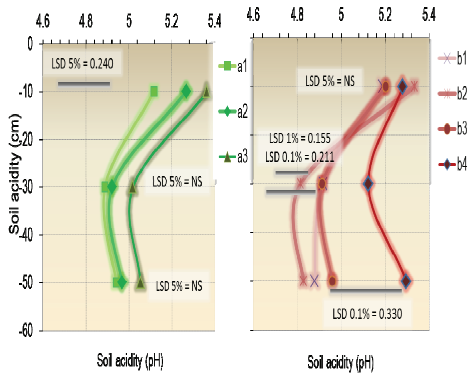

Fig. 3 Influence of soil type (a_1, a_2, a_3) and of the position in the terrace platform on pH values within the 3 soil depths (mean values of A/B experimental factors graduations) Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

The humus content (%)

In average, on the three soil types (a_1, a_2, a_3) and on the three depths investigated (0-20; 20-40; 40-60 cm), the highest value of the humus content (2.60%) was registered on the position from platforms downstream and the lowest value (2.14%) was registered upstream of the terrace platform (Fig. 4).

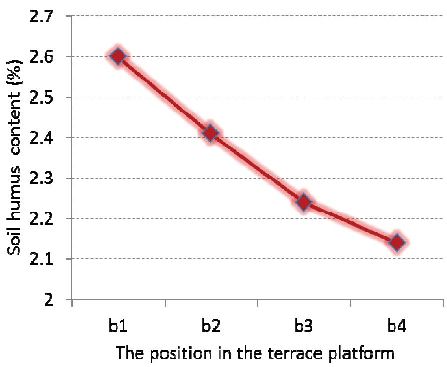

Fig. 4. The influence of the position in the terrace on the platform on the humus content %. (Average values on three soil types and 0-60 cm depth). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in chapter „Material and method"

The influence of the position inside the terrace platform (b_1, b_2, b_3, b_4), on three soil types (a_1, a_2, a_3) on the mobile phosphorus, mobile potassium and pH values

The mobile phosphorus content (ppm)

On the depth 0 - 20 cm, among the three soil types studied (a_1, a_2, a_3), the values of the mobile phosphorus content registered on the four positions of terrace platform (b_1, b_2, b_3, b_4) were significantly differentiating among them, only in the case of the typical eutricambosoil (a_3). In the case of this soil type, the value of mobile phosphorus content registered on the b_1 position of the terrace platform (64.07) was distinct significantly higher with 243-274%, compared with the values registered on the positions b_3 and b_4. On the depth 20-40 cm, on the slightly eroded eutricambosoil (a_2), the value of mobile phosphorus content registered on b_1 position from the platform terrace (21.233 ppm), was significantly higher with 73%, compared with the value registered on the position b_4 (12.3) and distinct significantly higher with 165 - 218%, compared to the values registered on the positions b_2 and b_3. At the depth 40-60 cm, on the slightly eroded eutricambosoil, the value of the mobile phosphorus content registered on the b_4 position of the terrace platform (15.5) was significantly higher 111% compared with the value registered on the position b_2 (7.333) - Fig 5.

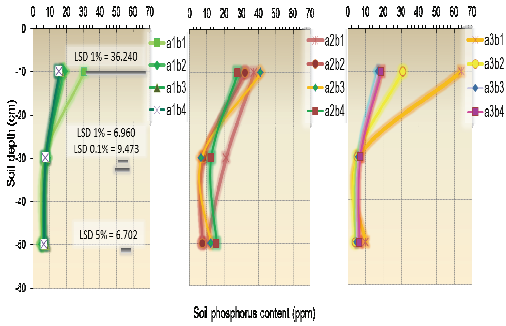

Fig. 5. Influence of the position in the terrace platform on P content within 3 soil types and their 3 depths (interaction of A/B experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method"

The mobile potassium content (ppm)

On the depth 0 - 20 cm, on the eutricambosoil with coluvic character, the mobile potassium value registered in the position b1 of the terrace platform (318.17 ppm) was distinct significantly higher with 99% compared with the value registered on the b_3 position (160.0 ppm). At the same depth, on the slightly eroded eutricambosoil, the value of mobile potassium content registered on b_2 position (386.7 ppm) was significantly higher with 64% compared with the value registered on b_4 position (236.7) and distinct significantly higher with 77% compared with the value registered on the b1 position (218.7 ppm). In the same way, on the typical eutricambosoil (a_3), the potassium content value registered on b_1 position (288.0 ppm) was significantly higher with 83% compared to the value registered on the b_3 position and distinct significantly higher with 134% compared with the value registered on the b_4 position (123.3%). At the depth of 20-40 cm, on the slightly eroded eutricambosoil, the value of the mobile potassium content registered on b_2 position (245.3 ppm) was significantly higher with 116%, compared with the value registered on b_1 (113.3 ppm) and distinct significantly higher with 159 - 175% compared with the values registered on the positions b_3 and b_4 (Fig.6).

The pH values

On the depth 0 - 20 cm, on the slightly eroded eutricambosoil the pH value registered on b_2 position (5.473) was significantly higher with 7.5% compared with the value registered on b_1 position, placed downstream the terrace platform (5.093).
On the depth 20 - 40 cm, on the eutricambosoil with coluvic character (a1), on b_4 position, situated upstream of terrace platform, the pH values (5.093) was significantly higher with 6.8%, compared with the pH values registered on the positions b_1 and b_2. At the same depth, on slightly eroded eutricambosoil, the pH value registered on b_1 position, situated downstream the terrace platform (5.070) was significant higher with 4.7 - 7.5 % compared with the values registered on the positions b_2 and b_3 placed in the middle of terrace platform.

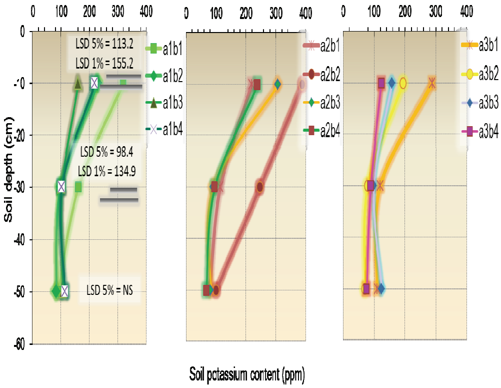

Fig. 6. Influence of the position in the terrace platform (b_1, b_2, b_3, b_4), on K content within the 3 soil types (a_1, a_2, a_3) and their 3 depths (interaction of B/A experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in Chapter „Material and method".

Also, at the same depth (20-40cm), on the typic eutricambosoil a_3, the pH value registered on the position placed upstream terrace platform (5.213) was significantly higher with 4.8 - 5.1% compared to the values registered on the positions b_2 and b_3 situated in the middle of the terrace platform and distinct significantly, higher with 6%, compared with the value registered downstream the terrace platform (4.920) - Fig. 7.

Influence of A, B experimental factors graduations on the variation coefficients values (%) (Average values for phosphorus and potassium content and pH values on threes soil depth

In average, on the four positions delimited on the terrace platform (b_1, b_2, b_3, b_4), among the three soil types (a_1, a_2, a_3), the highest value of the variation coefficient for the three analyzed chemical components, was registered in the case of typical eutricambosoil (36.2%).

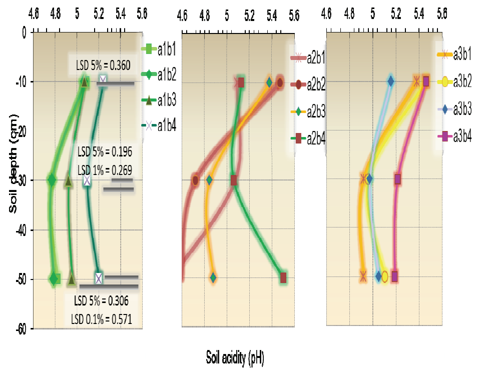

Fig. 7. Influence of the position in the terrace platform (b_1, b_2, b_3, b_4), on 3 soil types (a_1, a_2, a_3), on the pH values within 3 depths (interaction of B/A experimental factors graduations). Significance of the experimental factors graduations (a_1, a_2, a_3 and b_1, b_2, b_3, b_4) is shown in chapter „Material and method".

This value was 2.2% higher compared with the one registerd in the case of slightly eroded eutricambosoil (35.4%) and with 78% compared with the value registered on the eutricambosoil with coluvic character (20.3%). In average, on the three soil types and three soil depths analyzed, the highest value of the variation coefficient for the three analyzed chemical components, were registered in the case of b_1 position (35.6%), followed by the very similar values registered in the case of b_2 position (32.3%) and b_3 position (32.1%); the highest value was registered in the case of b_4 position (26.4%). In average, on the seven graduations of the experimental factors A and B, the highest value of the variation coefficient was registered in the case of the phosphorus content (47.7%), followed by the registered value in the case of the potassium content (41.8%), and finally on the last place was the value registered in the case of the pH values (4.1). In consequence, the uniformity of the individual values of pH was much higher than the individual values of phosphorus and potassium content.

The data presented until now regarding the four chemical characteristics revealed a light tendency of decreasing from the downstream to the upstream of the terraces platform of the humus, mobile phosphorus and mobile potassium content and a light increase in the same direction of the pH values in the more profound soil depths. By comparing, the differentiation of registered values belonging to the chemical components with the data presented by [8] one can observe that in the case presented, the differences were very small. The fact, can be explained by the different methods used in two situations for terraces building.

Table 1. Influence of A, B experimental factors graduations of the variation coefficient (%) (mean values of P, K and pH contents studied) within three soil depths

Experimental factors graduations a, b	Phosphorus (ppm)	Potassim (ppm)	pH	Average
a_1	24.1	33.3	3.6	20.3
a_2	50.9	49.4	5.8	35.4
a_3	61.1	43.8	3.8	36.2
b_1	62.8	40.4	3.4	35.6
b_2	35.7	56.8	4.4	32.3
b_3	54.7	39.1	2.7	32.1
b_4	44.5	29.5	5.2	26.4
Average	47.7	41.8	4.1	

As previously was shown in the present work, the terraces building was realized by the integral preservation of the fertile soil layer on the terraces platform surface. In the case of the work presented by [8] the vegetal soil layer was mixed in the soil profile. This was done in the moment of soil movement for terraces building, from upstream to downstream of the further terraces platforms. By comparing the differences between the values registered upstream and downstream of the terraces for the four chemical components analysed, it can be observed that the highest differences were registered in the case of the mobile phosphorus. Despite these facts, the data presented in Fig. 5 revealed that among the three soil types these differences regarding the mobile phosphorus were registered only on two from the three soil types studied. The high differences between the two positions inside the terrace platform registered for the mobile phosphorus compared to the ones registered for the mobile potassium can be explained by the higher differentiation on the soil profile [3] of the mobile phosphorus compared to the ones registered for the mobile potassium.

CONCLUSIONS

In average, for the three soil types and the three soil depths (0-20; 20-40; 40-60 cm), the chemical components values registered on the position situated downstream the terrace platform, compared to the ones registered upstream the terrace platform were 64% higher in the case of the mobile phosphorus, 25% in the case of the mobile potassium, 21% in the case of the humus content. The mobile phosphorus values registered downstream the terrace platform were higher compared to the ones registered upstream the terrace platform only for two of the three soil types studied.

Under the same conditions, the pH values registered on the position from upstream terrace platform were 6% higher compared to the ones registered downstream the terrace platform, the differences being more evident on the more profound soil layers (20-40; 40-60 cm).

Regarding the analysed chemical components, the differences between the values registered downstream the terrace platform and the ones registered upstream the terrace platform, were much lower in the present work compared to the ones presented in the literature. This fact can be explained by the different methods used in the two situations for terraces building.

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