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Kratko saopštenje – Short communication

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ČASOPIS NAUČNOG VOĆARSKOG DRUŠTVA SRBIJE I CRNE GORE

Planting in trenches - a promising method for establishing orchards in the mountain regions

Hristina Dinkova, Kalin Dragoyski, Penka Mihaylova

Research Institute of Mountain Stockbreeding and Agriculture, Troyan, Bulgaria
E-mail: inst@instroyan.com

Content: At the Research Institute of Mountain Stockbreeding and Agriculture, in Troyan, a method has been developed for trench digging and filling with organic manure as reserve during the pre-planting preparation of sites for new perennial plantations. The method proved very effective for the pedoclimatic conditions of the Central Balkan Mountains. The plum trees grow vigorously, bear fruit abundantly, and until reaching the age of 10 they do not need any additional nutrition. The water erosion risk has been brought down to the minimum by combining the trench planting method sod on the inter-row alleys.

Key words: Plum, trench-planting, manure application, soil cultivation.

Introduction

A great part of the agricultural land in Bulgaria (47%) is located on sloped ground, with shallow soils, poor in humus and strong gleyzation (Penkov, 1983). With frequent rainfalls they are subject to water-logging, while the gradient is an additional precondition for water erosion processes. Thus there is a set of disadvantages that renders these soils as low fertility and inappropriate for the greater part of crops suitable for growing in temperate climate regions. Practice and tradition prove that they favour growing myrobalan, plum, raspberry, currants and some other small fruit species. However, in order to achieve their normal development and regular and abundant fruit-bearing, optimal soil tillage should be provided, combined with nutrition and plant protection measures (Dinkova et al., 2000). The soil tillage is necessary for aeration of heavy soils and improving their water permeability, but holds risks for retaining and improving soil fertility grade. These reasons necessitate search for an integrated approach to pre-planting soil preparation that will ensure agrobiological conditions needed for plants growth and development, guaranteeing erosion control of the area. Such an approach should accomplish the effect of deep soil loosening without deep

ploughing, which will provide plants with nutrients and moisture without fertilizer application or irrigation.

The trench planting method fully satisfies the above stated conditions. Herein we shall dwell on its description and effects on soil plants.

Material and method

The trench planting method was first applied at RIMSA, Troyan, in 1986, whereas this investigation whwrwas performed from 1994 to 2003, by conducting two field trials and a number of soil analyses.

The first trial was set in a plum orchard established in 1994 with the cultivars Stanley, Gabrovska and Strinava, and using two methods of preplanting soil preparation: 1) Traditional method (deep ploughing at 50 *cm* depth, digging of planting holes, filling them with 20 *kg* of manure, 200 *g* superphosphate and 200 *g* potassium phosphate); 2) Trench planting (twofold deep ploughing of the rows only by PNU-50 type of plough and dressing with 65 - 70 *kg*/*m* of manure).

This paper will dwell only on the growth and fruiting performance of cv Stanley, by reading the trunk girth (*cm*), crown volume (m^3, from the third year onward), annual growth in terms of number of branches, total length of annual growth (*cm*), and fruit yield as *kg* per tree.

The second trial was set in a plum orchard planted by trench method, in 1998, with the cultivar Čačanska lepotica. The trenches were filled with components - rotted manure, fresh manure and apple waste product, aimed at improving physical and mechanical properties of soil. Six years later comprehensive chemical analysis of the filling materials determined the changes in amounts and forms of N and P at different soil depths. The soil samples were collected from the trenches by a probe at depths of 0 - 30 *cm* and 30 - 60 *cm*. The samples were air-dried and cleared from roots and other impurities. The analyzed traits included: pH - by a glass electrode; total nitrogen - after Kjeldahl; total mineral nitrogen (ammonium and nitrate forms) after Bremner and Keeny; assimilable phosphorus - after the method of Mehta et al.

The trench planted trees did not receive any fertilization or irrigation. The plant protection measures complied with the technology for plum fruit production.

Results and discussion

Trench planting of cv Stanley creates optimal conditions for their growth. The values of some traits measured in individual years were lower for the experimental trees than for those planted by the traditional method, e.g. values for trunk girth (1995), number of annual branches (1995, 1996, 1998, 1999), crown volume (1996, 2001), total length (1995, 1996, 2001). However, the average results for the 8-year experimental period supplied convincing proofs that trench planting enhanced the growth of cv Stanley trees (Tab. 1). The greatest difference registered in the total growth amounted to 25% in excess of the traditionally planted trees.

Tab. 1. Growth performance of the trees of cv Stanley
Prirast stabala sorte Stenli

Year *Godina*	Trunk girth *(cm) Obim debla*		Number of annual branches *Broj jednogodišnjih grančica*		Crown volume (m^3) *Volumen krune*		Total length of annual wood growth (*cm*) *Ukupna godišnja dužina rasta grana*	
	Planting holes *Jame za sađenje*	Trenches *Rovovi*	Planting holes *Jame za sađenje*	Trenches *Rovovi*	Planting holes *Jame za sađenje*	Trenches *Rovovi*	Planting holes *Jame za sađenje*	Trenches *Rovovi*
1995	10.3	9.6	7.7	6.5			353.2	314.5
1996	13.4	13.7	16.9	11.8	2.35	2.16	684.2	588.6
1997	18.6	19.4	27.9	36.0	4.64	4.93	1,299.5	1,565.5
1998	23.8	24.8	45.4	43.7	8.10	9.57	1,322.3	1,723.7
1999	28.9	30.1	52.2	42.4	12.70	14.11	1,596.7	1,877.7
2000	29.9	31.4	52.7	55.7	13.57	15.00	686.0	1,515.1
2001	33.8	36.4	63.1	77.0	15.25	15.20	3,100.7	3,085.6
2002	35.5	37.4	29.3	33.2	11.55	15.00	245.0	958.5
Average *Prosečno*	24.3	25.4	36.9	38.3	9.65	10.85	1,161.0	1,453.8

Taking into account the fact that inter-rows were grassed down and trees had vigorous growth, it can be concluded that the issue of competition for water and nutrients among grass species and trees was not a problematic one.

Tab. 2. Fruit yield, of cv Stanley (*kg*/tree)
Prinos sorte Stenli (kg/stablu)

Year *Godina*	Trenches/*Rovovi*		Planting holes/*Jame*	
	kg/tree *kg/stablu*	*kg*	*kg*/tree *kg/stablu*	*kg*
1997	1.2	49.9	2.0	83.2
1998	5.7	237.1	6.0	2,49.6
1999	15.0	624.0	14.0	582.4
2000	28.0	1,154.8	22.0	915.2
2001	40.0	1,664.0	35.0	1456
2002	56.0	2,329.5	46.0	1,913.6
Total/*Ukupno*	145.9	6,059.34	125.0	5,200.0

Cv Stanley is a good and regular cropper. The total fruit yield per tree and per 1 da were higher from trench-planted trees (Tab. 2).

Similarity was found in the growth and reproductive performances of the trees, the advantages being for the trench planted ones rather than for those planted in holes after deep ploughing. For greater clarity, however, we need to have better knowledge of the processes that take place in the soil. The answers to this were obtained from the second trial results. Data from the analyses performed in the year of establishment were published in another paper (Dinkova et al., 1996).

As there are missing results of chemical analysis of manure in trench planting with cultivar Stanley we present such with cultivar Čačanska lepotica.

Tab. 3. Chemical composition and pH Čačanska Lepotica value of soil in the experimental plum orchard of cv established using the trench method
Hemijski sastav i pH vrednost zemljišta u eksperimentalnom zasadu šljive sorte Čačanska lepotica podignutom po metodi rovova

Treatments *Tretmani*	Depth *(cm)* *Dubina*	pH (H_2O) *pH (H_2O)*	Total N (%) *Ukupan N*	Sum of NH_4- N+ NO_3-N *(mg/100 g)* *Iznos NH_4- N+ NO_3-N*	Assimilable P *(mg/100 g)* *Pristupačni P*	Total P *(mg/100 g)* *Ukupan* P
Apple waste product	0 - 30	4.5	0.062	13.26	1.39	35.96
Otpadni materijal jabuke	30 - 60	6.8	0.591	16.21	30.05	133.73
Fresh manure	0 - 30	7.1	0.205	10.31	24.28	53.54
Sveži stajnjak	30 - 60	7.3	0.443	11.79	71.97	197.14
Rotted manure	0 - 30	5.8	0.087	4.57	20.65	56.21
Zreli stajnjak	30 - 60	6.5	0.503	3.05	72.76	152.38

Data in table 3 show that the application of organic nutrients produced favourable pH elevation at the area of applying (to a depth of 30 - 60 *cm*).

The contents of total nitrogen in Treatment 1 (apple waste) in the 0 - 30 *cm* layer was low – 0.062%, which is nearly the same as the natural soil contents. However, in the 30 - 60 *cm* layer this amount increased 9.5 times.

In Treatment 2 (fresh manure) there was a slight elevation of the total nitrogen level (0.205%), probably due to the mixing of organic matter with the surface layer. In the area of applying the organic matter the amount was significantly increased – 0.44% N.

In Treatment 3 (rotted manure) elevated amounts of N were found at both depths, but at 30 - 60 *cm* the values were higher. The nitrogen amounts measured were rather small compared with the input ones, which indicates that the main part of the organic matter underwent mineralization. The latter process was more intensive in treatments 2 and 3 (with fresh and rotted manure).

The sum of mineral nitrogen forms (ammonium and nitrate ones) was low both in surface and deeper soil layers. The values found in the surface layer were typical for that soil type, while those in the 30 - 60 *cm* layer were probably the result from nitrogen lost or consumed after mineralization of the main part of input organic matter. The lowest nitrogen values in Treatment 3 indicate that the mineralization there was most advanced.

The total phosphorus content was 35.96 *mg* P/100 *g* soil in the 0 - 30 *cm* layer in the first treatment which is normal for the soil type, and 53.54 and 56.21 *mg* P/100 *g* soil in Treatments 2 and 3 accordingly (Tab. 3). The 30 - 60 *cm* layer, though, was strongly enriched, and the values determined were 133.73 mg P/100 *g* soil in the first treatment, 152.38 *mg* P/100 *g* soil in the third one and 197.14 *mg* P/100 *g* soil in the second one.

The assimilable phosphorus at 0 - 30 *cm* depth was in the lowest amounts in Treatment 1 - 1.39 *mg* P/100 *g* soil and the highest one 24.28 *mg* P/100 *g* soil in Treatment 2. The greatest increase at 30 - 60 *cm* depth was recorded for the treatment with apple waste reaching 30.05 *mg* P/100 *g*. In the other two treatments the values were approximate - 71.97 and 72.96 *mg* P/100 *g*.

Conclusion

The trees planted in trenches grew more vigorously than those planted in holes after deep ploughing.

The fruit bearing pattern was regular and in optimal amounts, in accordance with the productive potential of cv Stanley.

The fruits of the trench planted trees were produced without application of fertilizers, relying only on the single reserve application of manure.

The soil chemical assay found that the trench method including organic manure input provided richer reserve of nutrients, which was much above the optimal nutrition rates. In the area of organic matter input (30 - 60 *cm* layer) elevated nitrogen levels were read, which points to mineralization of the greater part of organic matter. Conversely, the contents of mineral nitrogen was low and in the future one cannot expect release of high amounts of mineral nitrogen from the organic manure input.

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SADNJA U ROVOVIMA - PERSPEKTIVAN METOD PODIZANJA ZASADA U PLANINSKIM OBLASTIMA

Hristina Dinkova, Kalin Dragoyski, Penka Mihaylova

Institut za istraživanja u poljoprivredi i planinskom stočarstvu, Troyan, Bugarska
E-mail: inst@instroyan.com

Rezime

U Institutu za istraživanja u poljoprivredi i planinskom stočarstvu u Trojanu razvijen je metod po kome se iskopani rovovi pune stajnjakom, a koriste se kao rezerva, neposredno pre sadnje, u pripremi parcele za podizanje višegodišnjih zasada. Ovaj metod pokazao se vrlo efikasnim u pedoklimatskim oblastima balkanskih planina.

Stabla šljive su bujna, obilne rodnosti i do desete godine starosti ne traže dodatnu ishranu. Rizik od erozije sveden je na minimum kombinovanjem sadnje u rovovima i nanošenjem busenova između leja.

Ključne reči: Šljiva, sadnja u rovovima, primena stajnjaka, obrađivanje zemljišta.

Author's address:
Dr Hristina Dinkova
Research Institute of Mountain Stockbreeding and Agriculture
281, Vasil Levski Str.
500, Troyan
Bulgaria