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Evaluation of Chakvi Red Soils and Secondary Phytocoenoses Developed On Them

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Abstract:

The given work envisages results of physical-chemical parameters of red soils in Chakvi (Adjara A.R., Georgia) and multi-element analysis for the purpose of identification and evaluation of their chemical composition and modern fertility level. Besides, in the given work the present conditions of naturally formed co-societies are reviewed which are resulted from irrational usage of phyto-landscapes of seaside Adjara, their anthropogenic influence and abandoning and neglecting agricultural land plots; the peculiarities for development of secondary phytocenoses being formed via mutual participation of aborigine and adventitious species are studied. The research has showed that research soils are acidic; they are poor in general humus and nitrogen. From macro-elements K, Mg, P are with minimum concentration and Cd, Cr, Hg, Li, Sb, Se, Ti, Tl, V, Pb are beyond the permissible concentration norm. The concentrations of microelements As, Ba, Cu does not exceed MPC. Phyto-cenotic structure is formed in parallel with growth of coniferous plants via gradual introduction of cenotic inter-relations which is differentiated like rows. Formed secondary phytocenosis are characterized with high potential of species of foreign origin (adventitious). At present stage of restoration successive change in serial phytocenosis totally 63 families, 137 breeds, 191 species from which local is 61 and 130 of a foreign origin are described.

Key Words: *Red soils, fertility, multi-element analysis, secondary phytocenosis, adventitious species.*

Introduction.

Almost all types of soils are met in the territories of Georgia starting from red soils of subtropical zone of western Georgia ending with mountainous-meadow soils of hilly areas. The main soil types of Georgian subtropical zone where various agricultural lands are located are red soils, yellow soils and subtropical bleached soils. Red soils are widely distributed in subtropical hilly foothill zone of western Georgia. They are represented with highest percentage in Adjara region, from 80 to 200 m height above sea level [1, 2]. The dominant crops are citrus and tea at most territories of them. At present tea is changed mostly by nuts and annual crops. The most common soil-producing rocks of red soils are the products exhausting volcanic mountainous rocks: andesite, basalts, tuffs, clays and loamy soils (pic.1). The main source of collecting humus in red soil is "Kolkheti Type" forests under which they have been formed. The high saturation of roots and aluminum in absorbed conditions together with hydrogen causes acidic reaction of the mentioned soils [3, 4, 5]. On the basis of non-desirable socio-economic conditions of Georgia since past 90s some part of red soils (especially territories where tea plantations were cultivated) are degraded and abandoned at present. The only way out from the mentioned conditions is evaluation of modern conditions of red soils, for the purpose evaluation and enhancing their fertility level.

Pic. 1. Soil-forming rock of Red soi

Adjara flora is distinguished with special diversity and originality which is stipulated by ancient plant groups and relicts formed in the third period (Palaeogene). Since ancient times the southern part of densely populated Kolkheti – Adjara Flora was enriched by foreign species. In the last decades of the past centuries strengthened colonization of adventitious plants was vividly expressed and formation of secondary phytocenosis by them. Therefore, it has become more and more common reaching and introducing invasients in aborigine plants. Herewith, foreign plants invase in local flora and exotic species

become wild. The wide distribution of adventitious species made local natural flora incognizable, many of them invased in agro-cenosis and became grass [6].

In the first decades of twentieth century the formation of agrocenosis of various crops was followed by formation of secondary (changed) plants (mostly grass) in the place of mixed-leafy forest in seaside bar and hilly areas. Since 1885 tea plantations are cultivated in Chakvi territories. The invasion and introduction of many foreign species is connected to cultivation of tea plantations [7, 8, 9]. This is a long-term and still on-going process. At the end of twentieth century since tea plantation are considered to be non-profitable crops, agro-chemical and other activities were terminated and local and foreign coniferous plants start growing together with grass in tea plantation territories. The spectrum of coniferous plants distribution is well envisaged in Google map photos (Pic 2, 3). Hence, studying adventitious species will create a clear picture about their gradual invasion in a new environment, and will show modern transformation peculiarities of flora and plants with the influence of anthropogenic factors.

Pic.2. Research object (2004)

Pic.3. Research object (2017)

The research goal was the following: to identify chemical composition of red soils in Chakvi area and evaluation of their fertility level with main parameters; as well as, studying secondary phytocenosis of Chakvi bar area, geo-botanic diagnostics of naturally formed secondary phtytocenosis, formation of data base for foreign plants inhabited in research objects, taxonomic and geographical analysis, studying dynamics of successive processes.

Materials and Methods.

The used red soil samples were taken from Adjara A.R. Chakvi area, the samples were taken from two depths: 0-40, 40-80 cms. The research methods were: potentiometric, titrimetric, photo-colorimetric, Plasm Atomic Eissive Specter Analysis [10]. The research material in chakvi bar area in secondary natural cenosis was plants of local and foreign origin. Totally 5 objects were selected where geo-botanic descriptions were made through method of squares. The main research method was traditional route expedition method. For identification of species various data and scientific literature/sources were used

[11, 12]. Internet sources and data base of world invasive species. In secondary natural phytocenosis plants description is made through Releve and square methods [13, 14].

Results and Discussion.

Evaluation of Chakvi Red Soils Fertility Level, based on Their Agro-Chemical Parameters:

The tea crops were cultivated as red soils for a long period (more than 50-60 years) which caused strong acidic reaction of the mentioned soils. In 0-40 cm layer of the soil, where there are mostly agricultural crops root system, pH (H_2O) is 4.3-4.6, in KCl suspension - pH 4.0-4.5, according to the depth pH of the soils are increased (Table 1). By reducing pH the changeable and hydrolysis acidity of the soils are regularly increasing. Humus (in Latin *humus* - means land, soil) - is organic, dark part of soil which is produced through bio-chemical transformations of vegetal and animal residuals. Humus includes all the elements necessary for feeding the plant, which become easily assimilating for plants by the influence of microorganisms. The soils are poor in general humus (3.57-3.02%). Humus concentration regularly decreases according to the depths. General nitrogen is the sum of mineral and organic nitrogen, which is identified in order to have an idea on balance of nitrogen substances. It includes easily soluble nitrogen admixtures (nitrates, nitrites, ammoniacal nitrogen), as well as hardly soluble nitrogen organic admixtures (mostly nitrogen in proteins). Organic-mineral admixtures in Nitrogen is one of the most important nutritious components. According to the received results it was identified that general nitrogen is 5% of general humus.

Multi-element analysis of red soils showed that from macro- and semi-micro elements, Al (93.7mg/kg) > Fe (48.06 mg/kg) > Si (41.6 mg/kg) are dominant. Macro-elements are in the first row according to their composition: Al > Fe > Si > Ca > Mg > K-P > N (Diagram 1). From necessary macro-elements used for feeding plants K, Mg, P are with minimum composition. The soils are poor for absorption forms level of Potassium and Phosphorus. The composition of Calcium and Magnesium movable forms in soils are not sufficient for feeding plants.

Table 1

Basic Fertility Parameters of Chakvi Red Soil

Place of Taking Sample	Depth of Taking Sample, cm	pH		Acidity, mg.equivalent/l		General, %		Nutritious Elements, mg/100g			
		H_2O	KCl	Chan-geable	Hydro-lysis	Humus	N	P_2O_5	K_2O	CaO	MgO
Chakvi	*0-40*	4.3	4.0	6.2	13.0	3.57	0.15	15.5	13.4	16.8	11.5
	40-80	4.6	4.5	5.0	10.0	3.02	0.12	13.0	9.3	15.4	11.0

Toxic elements are beyond discovering norm in soils where tea plantations used to be: Cd, Cr, Hg, Li, Sb, Se, Ti, Tl, V, Pb. The determined micro-elements are classified as follows according to decrease: Mn>Mo>B-Cu> Co-Zn > As (Diagram 2, Table 2). Composition of microelements including toxic elements does not exceed MPC in any soil samples. Among defined microelements Mn (17.3 mg/kg) was with the highest concentration, which once more underlines the acidic reaction of red soils where tea plantations used be. Molybdenum was with minimal concentration in soils (0,0277mg/kg).

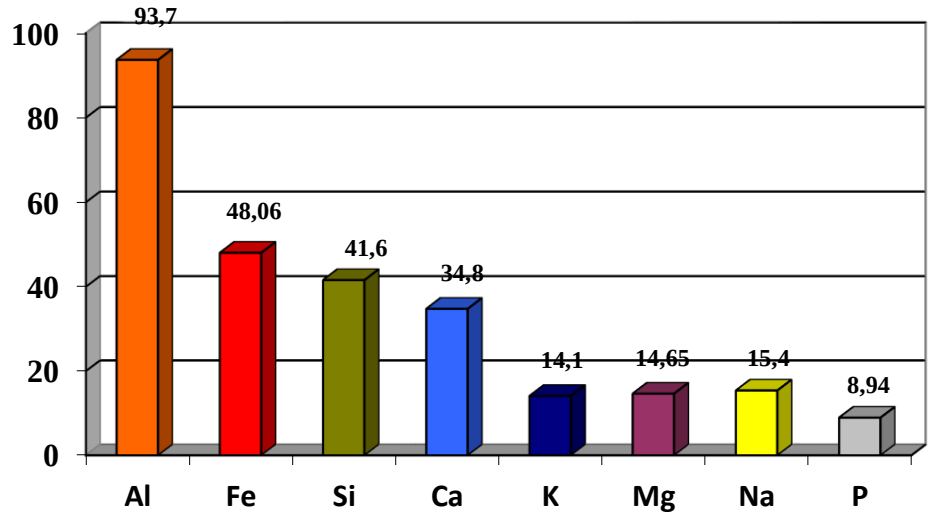

Diagram 1. Multi-element composition of red soil, macro-elements, mg/kg

Table 2

Element analysis of Soil Acid Extract (0,1 N H_2SO_4), mg/kg micro-elements (including toxic)

Elements mg/kg / Location	As	B	Ba	Co	Cu	Mn	Mo	Zn
Chakvi	1.60	0.421	1.84	2.19	1.76	17.3	0.0277	0.723
MPC, mg/kg	2,0	55	2,5	5,0	3,0	70-80	3,5	1,0

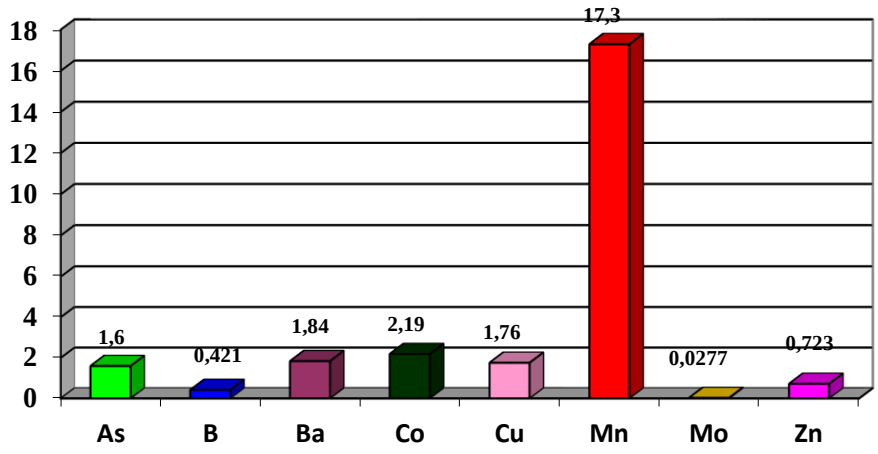

Diagram 2. Multi-element composition of red soil, micro-elements, mg/kg

Floristic and cenotic analysis of secondary phyto-cenosis in Chakvi Bar and hilly areas:

Based on background description and researches in Chakvi bar area four formations were selected and classified in secondary cenosis: plant groups created from Japanese criptometry (*Cryptomeria japonica*) dominance; plant groups created from hardbeam and oak dominance (*Carpinus caucasica, Quercus palustris, Quercus falcata*); plant groups created from alder (Carpinus caucasica, Cryptomeria japonica); Japanese hardhack and American edible pokeweed dominance (Alnus barbata, Spiraea japonica, Phytolacca americana) (pic. 3).

In secondary natural cenosis totally 63 families, 137 breeds, 191 species from which local is 61 and 130 of a foreign origin are described. In the nearest past in he mentioned territories deforestation of representatives of local flora – beech (Fagus orientalis), chestnut (Castanea sativa), hardbeam (*Carpinus caucasica)*, Hartvis oak (Quercus hartvisiana), teil (Tilia caucasica), phloem (Pterocarya pterocarpa), persimmon (Diospyros lotus), rhododendrons (Rhododendron luteum, R. ponticum) and others took place and tea plantations were cultivated. Though since agro-technic measures were terminated in plantations tea bushes were degraded. On the places where plantations used to be successive processes of naturally formed phyto-cenosis started by the participation of aborigine and (adventitious) species of a foreign origin.

In plant groups created with the dominance of Japanese kriptometries (*Cryptomeria japonica*) 71 species are described, from which 25 are local and 46+ are foreign. In tree-plant row Cryptomeria japonica is dominant, (height 8-10m)б Quercus falcata, Quercus palustris, Frangula alnus (height 2-4 m). sambucus nigra, Smilax exselsa, Lonicera japonica, Polygonum perfoliatum, Rubus caesius, Rubus hirtus, Rubus serpens are met in underwood. Tea bushes are covered with ferns(Pteridium tauricum). Two kinds of peat are met in open areas of groups (Polytrichum strictum, Calliergonella cuspidata). The grass cover is poorly developed, units of Castanea sativa, Corylus avellana, Aleurites fordii, Acer negundo are met.

In groups created by dominance of hardbeam and oak (Carpinus caucasica, Quercus palustris, Quercus falcata) 119 species are described from which 37 is local and 82 is foreign; 26 species of coniferous

plants from which 10 is local (Alnus barbata, Carpinus caucasica, Castanea sativa, Corylus avellana, Frangula alnus, Laurocerasus officinalis, Rhododendron luteum, R. ponticum, Vaccinium arctostaphylos, Sambucus nigra) and 16 foreign (Ailanthus altissima, Aleurites fordii, Cedrus deodara, Chamaecyparis lawsoniana, Cinnamomum glanduli-ferum, Cryptomeria japonica, Quercus acutissima, Q. falcata, Q. myrsinifolia, Q. glauca, Q. palustris, Mallotus japonicus, Rhus javanica, Robinia pseudoacacia, Spiraea japonica, Thea sinensis). Carpinus caucasica, Quercus palustris, Q. Falcata are dominant in coniferous species, other coniferous plants are met as single units. From liana plants Lonicera japonica, Polygonum perfoliatum, Smilax exselsa, Hedera colchika are met. The major territories are covered with ferns (Pteridium tauricum) and bushes (Rubus caesius,R. hirtus, R. serpens). In the mentioned cenosis dominance of hardbeam, rhodonendrons, plushes and laurel cherries and excess amount of grass species gives the prognosis for returning mono-climax co-societies.

In plant groups created by the dominance of alder (Alnus barbata), Japanese hardhack (Spiraea japonica) and American Phytolacca (Phytolacca americana) 106 species of plants are described from which 40 is local and 66 is foreign. From coniferous plants 7 (Alnus barbata, Acer pseudoplatanus, Cornus australis, Ficus carica, Hedera colchica, Hedera helix, Paliurus spina-christi) is local and 11 (Acacia dealbata, Acer negundo, Ailanthus altissima, Cedrus deodara, Cryptomeria japonica, Juglans ailanthifolia, Paulownia tomentosa, Platanus occidentalis, Quercus palustris, Rosa multiflora, Ulex europaeus) - is foreign. Lianas presented of Polygonum perfoliatum, Hedera helix, H. Colchica და Smilax excelsa.

Pic. 3. Secondary cenosis

In tree-plant row Alnus barbata is dominant , height 8-12 m. in the second row Spiraea japonica, Phytolacca americana are represented mostly. Projective coverage of grasses (Hydrocotyle ramiflora, H. Vulgaris, Duchesnea indica, Polygonum perfoliatum, P. posumbu, P. Thunbergii) - is high. 6 species of fern are described in group (Asplenium scolopendrium, Blechnum spicant, Dryopteris remota, Cyrtomium

falcatum, Pteridium tauricum, Thelypteris limbosperma). In formed cenosis more than 75% of plant species in formed cenosis are of a foreign origin.

Conclusion

Chakvi red soils are having acid reactions, the changeable and hydrolysis acidity importance regularly increases by reducing pH. The soils are poor in humus; general nitrogen concentration is 5 % of humus. From macro-elements Al, Fe, Si - is dominant. Soils are poor in elements - K, Mg, P. The movable forms concentrations of Calcium and Magnesium in soils are not sufficient for feeding the plants. Toxic elements are beyond discovering norm: Cd, Cr, Hg, Li, Sb, Se, Ti, Tl, V, Pb. From micro-elements Mn is dominant. The micro-elements concentration does not exceed MPC.

Irrational usage of natural plants, anthropogenic factors influence on them and ignorance and abandoning agricultural crops in Seaside Adjara phyto-landscapes caused peculiar transformation of flora and plants which was expressed in formed secondary phyto-cenosis which are characterized by high potential of invasion of foreign plants (adventitious). in secondary groups by the way of regular formation of cenotic inter relations, in parallel with growth of coniferous plants, phytocenotic structure is formed which is differentiated like rows. A certain system for natural rejuvenation is created. Based on background descriptions and researches in Chakvi bar areas in naturally developed secondary phytocenosis there are described 63 families, 137 breeds, 191 species from which local is 61 and 130 of a foreign origin.

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ჩაქვის წითელმიწა ნიადაგების შეფასება და მათზე განვითარებული მეორადი ფიტოცენოზები

ნინო კიკნაძე[1], ნანი გვარიშვილი[1], ი.მიქელაძე[2], ა. შარაბიძე[3], ს.ზოიძე[4],

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[2]უფროსი მეცნიერ თანამშრომელი, ბათუმის შოთა რუსთაველის სახელმწიფო უნივერსიტეტის ფიტოპათოლოგიის და ბიომრავალფეროვნების ინსტიტუტი

[3]ბიოლოგიის სპეციალობის დოქტორანტი, ბათუმის შოთა რუსთაველის სახელმწიფო უნივერსიტეტი, საბუნებისმეტყველო მეცნიერებათა და ჯანდაცვის ფაკულტეტი

[4]ქიმიის სპეციალობის ბაკალავრი, ბათუმის შოთა რუსთაველის სახელმწიფო უნივერსიტეტი, საბუნებისმეტყველო მეცნიერებათა და ჯანდაცვის ფაკულტეტი

აბსტრაქტი

სტატიაში წარმოდგენილია ჩაქვის (აჭარის ა/რ, საქართველო) წითელმიწა ნიადაგების ფიზიკო-ქიმიური მაჩვენებლების და მულტიელემენტური ანალიზის შედეგები, მათი ქიმიური შედგენილობის და ნაყოფიერების თანამედროვე დონის დადგენის და შეფასების მიზნით; განხილულია ზღვისპირა აჭარის ფიტო-ლანდშაფტებში ბუნებრივი მცენარეულობის არარაციონალური გამოყენების, მათზე ანთროპოგენური ფაქტორების ზემოქმედების და სასოფლო–სამეურნეო კულტურათა სავარგულების მოუვლელობა-მიტოვების შედეგად, ბუნებრივად ფორმირებული თანასაზოგადოებების არსებული მდგომარეობა; შესწავლილია აბორიგენული და ადვენტური სახეობების ერთობლივი მონაწილეობით ფორმირებული მეორადი ფიტოცენოზების განვითარების თავისებურებები. კვლევამ გვიჩვენა, საკვლევი ნიადაგები მჟავეა, ისინი ღარიბია საერთო ჰუმუსით და აზოტით. მაკროელემენტებიდან მინიმუმში იმყოფება K, Mg, P. აღმოჩენის ზღვარს ქვემოთ არის: Cd, Cr, Hg, Li, Sb, Se, Ti, Tl, V, Pb. მიკროელემენტების - As, Ba, Cu შემცველობა არ აღემატება ზდკ-ს. სახეობებს შორის ცენოტური ურთიერთკავშირების თანდათანობითი ჩამოყალიბების გზით, მერქნიან მცენარეთა ზრდის კვალდაკვალ, ფორმირებულია ფიტოცენოზური სტრუქტურა, რომელიც დიფერენცირებულია იარუსობრივად. ფორმირებული მეორადი ფიტოცენოზები ხასიათდებიან უცხო წარმოშობის (ადვენტური) სახეობათა ინვაზიის მაღალი პოტენციალით. აღდგენითი სუქცესიური ცვლის არსებულ ეტაპზე, სერიულ ფიტოცენოზებში სულ აღწერილია 63 ოჯახის, 137 გვარის, 191 სახეობა, მათგან ადგილობრივია 61, ხოლო უცხო წარმოშობისაა 130 სახეობა.

საკვანძო სიტყვები: *წითელმიწა ნიადაგი, ნაყოფიერება, მულტიელემენტური ანალიზი, მეორადი ფიტოცენოზი, ადვენტური სახეობები.*