



Nutrient Balance Under the Grape Plant in the Azerbaijan Arid Subtropic Zone Soils

MI Mammadov and MG Mustafayev*

Department of Agriculture, Azerbaijan

*Corresponding author: MG Mustafayev, Department of Agriculture, Azerbaijan

Received:  January 11, 2019

Published:  January 18, 2019

Abstract

The problems of the nutrient balance study under vineyards in the light-chestnut soils of Ganja-Gazakh of Azerbaijan are examined. 3,84kg/h of N/NH₃; 0,99kg/h of N/nO₃ P₂O₅ of 1,16kg/h penetrate into the soil with the atmosphere precipitations, but 1,73; 1,55; 1,05; 21,69kg/h with the irrigative waters. A total annual nitrogen-6,87-7,29%, phosphorus-0,59-0,79%, potassium-3,92-7,29% were leached from the scattered fertilizer into lizimeters. While a weight of the dry mass and a total quantity of the nutrient increase, an outlet with the annual trimming materials and crops has raised. It is established that a balance of nitrogen, phosphorous and potassium under all the versions of the experiment is positive. The balance under a control version where deficit of the nutrient is negative. At an application of fertilizer under the version of N₉₀P₁₂₀K₁₂₀ the balance forms for nitrogen +41, 8-(+44,6); phosphorus +102,2-(+110,1), potassium +81,1-(+85,6) kg/h.

Keywords: Balance; Trimming Materials; Fallen Leave; Nutrient; Entering and Carrying Parts; Deficit; Mineral Fertilizers

Introduction

The vine-growing and wine-making assume a vital importance for the country economy, from the supplemental value formation and economical rationality standpoint by playing a great role among the agrarian-industry areas. Our scientific-research works were connected with the definition of the ecologically innocuous fertilizer norms on the basis of the soil's fertility increase by the different methods, productivity raising, the crop quality improvement and balance calculations. Reduction of the mineral fertilizers production and import displayed itself in agriculture to raise the natural and anthropogenic degradation and also diversity occurring in the republic soils where the grape plant is grown. Therefore, the researches were carried out for the purpose of the fertility increase by applying the trimming materials and falling leaves of the grape plant into soil.

In the gardens where the grape plant has been grown for a long time, conducting the deep tillage and agrotechnical services mix the fallen leaves and trimming materials with the soil. While passing the years gradually the plant residues begin to be rotted under an influence of the air and humidity and mineralization process occurs. That's why unlike the other areas in the gardens

where the grape plant is grown the soil fertility was high. At present the balance calculations characterize systematically and therefore it is possible to observe the nutrient circulation in the agriculture. The nutrient which is necessary for the plant crop formation may be defined according to the balance calculations. Some works were printed about the nutrient balance, in agriculture for the different natural climate zones [1-4]. A main purpose of the work-preparing the fertilizing system more exactly, reviling the relation between the soil fertility and productivity by studying under grape nutrient balance.

Research Object and Methods

The long field researches were carried out by the grape sorts of "Bolgar" and "Cardinal" in the grey-brown (chestnut) and bright-brown soils of the Ganja-Gazakh massive from Azerbaijan. The grape areas in the grey-brown soils were irrigated by the canal waters being separated from the Tovuz river, but the areas in the bright-brown soils were watered by the canal waters being separated from the Shamkir river. Each area of the grape gardens was more than 100 hectares. The field experiments consist of 6; 8 versions and 4 secondaries. An area of each section is 204

m², nitrogen, phosphorus and potassium were used as mineral fertilizer, but manure, at the same time the trimming materials and leaves were used as organic fertilizer. 100% of phosphorus and potassium, 25% of nitrogen fertilizers were applied in inter-row in the autumn-winter season, 75% of nitrogen was applied in the spring. The field and laboratory researches were performed on the basis of the received methods [5-7].

An average annual temperature of the air is 12-13,2c but a sum of the annual active temperature (>10°C) is 4000-4700°C in the grey-brown soils of the zone. The frost layer is observed on soil surface in some years.

The average annual rainfalls quantity is 350-400mm and humidity coefficient vibrates by 0,3-0,5. The climate characters approve that grey-brown and bright-brown soil formation condition is auto morph. It is important to comment that the soils being used under tillage and garden are irrigated and this forms irrigation-hydromorph hydrological condition. Planting and growing of the grape plant under this condition for a long time was a reason for the soils morphological and morphometric peculiarities. The commented soils have a great importance economically.

Analysis and Discussion

The agrogen processes effect shows itself in the soil's fertility parameters firstly. The soils tilling or using under perennial tillages, interow deep ploughs are a reason for its surface disorder at 0-30sm and so on. These processes effect shows itself distinctly under arid climatic condition. Planting and growing the grape plant change the fertility parameters depending on a condition, effecting on soil forming process. Therefore, studying the processes is important theoretically and experimentally. One of the main-factors in an agro technical measures system is utilization from the correct fertilizing system corresponding to the soil-climate characters for getting high and qualitative crop from the agricultural plants [8]. One of the environment active and fast effecting outward factors is mineral fertilizer. The productivity rises by the applied mineral fertilizers increase. Apparently, the recommended norms of the fertilizers should be taken into account. In order to determine the fertilizers applied norms correctly it is necessary to know a fertilizer quantity which can be assimilated from soil by the plant and nutrient quantity will be added as fertilizer to obtain any crop. The nutrient penetrating into the soil with the mineral fertilizers concerns the entry balance part. An aim of the fertilizers applying is to restore the nutrient being extracted with a crop and to enrich the soil with the nutrient for the purpose of the product increase. An extraction of the nutrient from soils and its relationship with the rain erosion were studied in the researches being carried out with the grape plant in the Pends region of Spain. The nutrient extraction part has changed by 2,9-28,6%. This indication in heavy rains rises till 55,8-80,0%. The researches have showed that a great loss of the nutrient every year was observed in a little quantity of rainfalls and this loss overtook 60% [9].

The nitrogen concentration and its leaching from the soil surface was learnt and it was determined that a mean concentration of nitrogen (nitrates and nitrites) vibrated by 0,64-82mg/l as a result of one-meter soil, solution leaching in the researches being conducted in the Australia vineyards. During the surface leaching this parameter changed by 0,0-0,3kg/h [10]. To use correctly from mineral fertilizers by selecting their forms, defining their norms and ratios under the separate plants assume a great importance. As is obvious, long research works were performed with the mineral fertilizers under a grape plant and important consequences were obtained [1,3,11]. The nitrogen quantity which is entered with irrigative waters and is extracted with lizimetre waters has been studied with the purpose of learning the management of food balance in the light-chestnut (light-brown) soils of Ganja-Gazakh zone. Every year nitrogen with the atmosphere precipitations 5,85-7,38kg/ha, with irrigative waters 3,218kg/ha entered the soil. Under 90 versions 30,82mg of nitrogen non-assimilated by the grape plant has been extracted washing by the lizimeters [12]. Penetrating of phosphorus and potassium with the atmospheric residue and irrigating waters is studied with the purpose of regulation of nutritive balance in the light-chestnut soils of the Ganja-Gazakh region. It is established that the annual penetrating of phosphorus with the atmospheric residue forms 1,16-1,4kg/h; potassium-2,95-3,02kg/h, irrigating water-1,05-1,32kg/h; 21,69-29,5kg/h [13].

It was established by lizimetric experiments that leaching of nitrogen mainly occurs in the nitrogen form and forms (4,40; 4,3 kg/h) 6,95-7,29% from the applied fertilizer N₉₀P₁₂₀K₁₂₀. Phosphorus leaching is very weak in the soil; we can say that it isn't leached from applied fertilizer (P₁₂₀) form 0,75; 0,79%, but potassium is (K₁₂₀) 6,44; 7,29%. Thus the analysis of the lizimetric waters gives such an idea about a quantity and compositions of the nutrient leached from soils and applied fertilizers that it is necessary under study of the expenditure item of the balance. It was established by lizimetric experiments. It was determined that a quantity of the fell leaves was 17,0-29,0kg in 200m² of the section over the versions. A quantity of nitrogen was 0,59; 0,60%, phosphorus-0,37; 0,38%, potassium 0,89; 1,08% in the fell leaves of the versions of N₉₀P₁₂₀K₁₂₀ in which the mineral fertilizers were applied the extraction happened under this version in 2007-2008 was 9,52-10,29kg/h; phosphorus-5,18-5,51kg/h; potassium-12,47-15,71kg/h. This extraction belongs to the repeat reveting loss. The fell leaves decompose by mixing with soil during ploughing. As a result, phosphorus and potassium are restored gradually [14,15]. With the purpose of learning the nutrient quantity entering the soil by the different means and extracting from soil by a grape plant, the nutrient quantity entering the soil with the atmospheric precipitations and irrigative waters over 2007-2008 years were determined and this quantity was concerned the part of the balance elements with the mineral fertilizers being applied in the different norms.

Nitrogen with mineral fertilizers enters the soil-30; 60; 90kg/h, with the atmospheric precipitations-4,83-5,85kg/h, with irrigative waters-3/21-3,28kg/h, accordingly phosphorus-60; 90; 120kg/h, 1,16-1,41kg/h; 1,57-1,32kg/h, potassium 60; 90; 120kg/h; 2,95-3,02kg/h; 21,69-29,5kg/h. Penetrating of the soil total sum over the versions: 8,11-99,06 kg/h changed for nitrogen, phosphorus-2,21-122,7 kg/h; potassium 22,4-144,7kg/h (Table 1). As a result of the mineral fertilizers application under the grape plant the nutrient is extracted from soil by a crop, trimming material and leaves. Over the versions a quantity of the annual trimming materials was 32,0-43,0kg in 200m²-sectons. These indications by hectare are equal to 1600-2150 kg/h. A total nitrogen quantity in a dry mass over the versions formed 0,59-

0,72%, total phosphorus-0,32-0,42%, total potassium-0/33-0,57%. While raising the dry mass weight and nutrient quantity, an extraction also increased. So, an extraction on a control version: nitrogen-8,02; phosphorus-4,35; potassium-4,49kg/h, these indices in an application of the mineral fertilizers with a norm of N₉₀P₁₂₀K₁₂₀ increased accordingly 13,16; 7,76; 10,41kg/h. Under control version a total nitrogen quantity was 0,39-0,40% in a grape, phosphorus -0,04-0,05%; potassium-0,24-0,26%, but under a version of N₉₀P₁₂₀K₁₂₀ it was accordingly 0,52-0,53%; 0,09-0,10%, 0,36-0,43%, under a control version an extraction for nitrogen is 43,35-45,60kg/h, phosphorus 4,65-5,7kg/h, potassium-27,91-29,64kg/h. Under a version of N₉₀P₁₂₀K₁₂₀ it was accordingly 97,9-101,3kg/h, 16,9-19,1kg/h, 67,7-82,6kg/h.

Table 1: Nitrogen, phosphorus and potassium balance under a grape plant depending on mineral fertilizers applying doses.

Version	Inlet				Outlet								Balance
	by fertilizers	by atmospheric precipitations	by irrigative waters	a sum of entrances	leaching waters by the lizimetres	loss in a gas state	by the trimming materials	crop by a dry substance calculation s/h	a quantity %	extraction by a crop	a sum of extraction		
1	2	3	4	5	6	7	8	9	10	11	12	13	
Nitrogen													
Control	-	5,85	3,218	9,06	1,59	-	7,90	29,0	0,31	8,99	18,48	-9,42	
N30P60K60	30	5,85	3,218	39,06	2,63	4,15	12,39	36,5	0,37	13,50	32,67	+6,39	
N60P90K90	60	5,85	3,218	69,06	3,93	4,15	17,57	42,0	0,43	18,06	43,71	+25,35	
N90P120K120	90	5,85	3,218	99,06	4,40	4,15	22,31	47,2	0,50	23,60	54,46	+44,60	
Phosphorus													
Control	-	1,41	1,326	2,73	0,59		3,82	29,0	0,05	1,45	5,86	-3,13	
N30P60K60	60	1,41	1,326	62,73	0,76		5,50	36,5	0,06	2,19	8,45	+54,28	
N60P90K90	90	1,41	1,326	92,73	0,98		6,30	42,0	0,07	2,94	10,22	+82,51	
N90P120K120	120	1,41	1,326	122,73	1,00		7,31	47,2	0,09	4,24	12,55	+110,18	
Potassium													
Control	-	5,73	5,73	3,67		20,97	19,8	0,36	7,12	31,76		-26,03	
N50P50K60	60	5,73	65,73	4,54		29,18	25	0,48	12	45,72		20,01	
N100P100K120	120	5,73	125,73	5,63		33,58	27,6	0,6	16,56	55,77		69,96	
N150P150K150	150	5,73	155,73	7,17		38,29	29,2	0,72	21,02	66,48		89,25	

The fallen grape leaves quantity at 200m²-section over the versions was 17,0-29,0kg. Under a control version a total nitrogen quantity of the fallen leaves formed 0,50-0,51; phosphorus 0,26-0,27%; potassium 0,31-0,33%. Under version of N₉₀P₁₂₀K₁₂₀ accordingly N-was-0,59-0,60%; P₂O₅-0,37-0,38%, K₂O-0,57-0,62% (Table 2). So, the nutrient quantity being extracted by a crop and dry mass increased with the mineral fertilizer application. The mineral fertilizers have a definite influence on accumulation of nitrogen, phosphorus and potassium combinations in the grape

vegetative organs. Under all the versions a high quantity of nitrogen and phosphorus was observed in the leaves, but potassium in the plant shoots [2]. The long field and laboratorial experiments were carried out with the grape plant sort of "Tabriz" in the grey-brown (chestnut) soils for the purpose of returning the nutrient being extracted from the soil by the trimming materials and fallen leaves. It was known that raising the nutrient in soil was possible by applying the smashed dry mass being collected from 200m²-section in the same area [16].

Table 2: Nitrogen, phosphorus and potassium balance under a grape plant depending on mineral fertilizers applying doses.

Version	Inlet				Outlet								Balance
	by fertilizers	by atmospheric precipitations	by irrigative waters	a sum of entrances	leaching waters by the lizimeters	loss in a gas state	by the trimming materials	crop by a dry substance calculations/h	a quantity %	extraction by a crop	a sum of extraction		
1	2	3	4	5	6	7	8	9	10	11	12	13	
Nitrogen													
Control	-	4,83	3,288	8,11	1,48	-	8,16	28,50	0,28	7,98	17,62	- 9,51	
N30 P60 K60	30	4,83	3,288	38,11	2,41	4,15	13,56	36,62	0,39	14,28	34,40	+ 3,61	
N60 P90 K90	60	4,83	3,288	68,11	3,64	4,15	18,70	42,37	0,45	19,06	45,55	+ 22,56	
N90 P120 K120	90	4,83	3,288	98,11	4,43	4,15	23,76	47,82	0,50	23,91	56,25	+ 41,86	
Phosphorus													
Control	-	1,16	1,057	2,21	0,59	-	4,35	28,50	0,05	1,42	6,36	- 4,15	
N30 P60 K60	60	1,16	1,057	62,21	0,76	-	5,97	36,62	0,07	2,56	9,29	+ 52,92	
Control	-	4,83	3,288	8,11	1,48	-	8,16	28,50	0,28	7,98	17,62	- 9,51	
N30 P60 K60	30	4,83	3,288	38,11	2,41	4,15	13,56	36,62	0,39	14,28	34,40	+ 3,61	
Potassium													
Control	-	5,73	5,73	3,67		20,97	19,8	0,36	7,12	31,76		-26,03	
N50P50K60	60	5,73	65,73	4,54		29,18	25	0,48	12	45,72		20,01	
N100P100K120	120	5,73	125,73	5,63		33,58	27,6	0,6	16,56	55,77		69,96	
N150P150K150	150	5,73	155,73	7,17		38,29	29,2	0,72	21,02	66,48		89,25	

The loss of nitrogen in a gas state was taken into consideration in learning of balance. At a laboratorial experiment a loss of ammoniac in a gas state of the bright-brown (chestnut) soils was defined. This loss formed 4,15% (Table 1). According to the balance calculations a positive balance was obtained under all the versions which in the mineral fertilizers have been applied. Under a version of N30+3,61(+6,39), N-60+22,56-(+25,35), N₉₀-+41,86-(+44,60)kg/h; P₆₀-+52,92-(+54,28), P₉₀-+81,26(+82,51), P₁₂₀- +109,26(+110,18) g/h; K₆₀-+46,24-(+48,0), K₉₀+64,05-(+65,59), K₁₂₀-+81,13-(+85,69)kg/h. Under a control version a deficit of nitrogen, phosphorus and potassium was observed. Nitrogen-9,42(-9,51), phosphorus-3,13(-4,15), potassium-2,29(-2,92) kg/h (Table 2).

Conclusion

a) In 2007-2008 years 4,83-5,85kg/h of nitrogen; 1,16-1,41kg/h of phosphorus; 2,95-3,02kg/h of potassium entered the soil by the atmospheric precipitations, but 3,21-3,28; 1,05-1,32; 19,51-21,69kg/h of the nutrient entered by the irrigative waters in the Ganja-Gazakh region of Azerbaijan.

b) Yearly 6,87-7,29% of nitrogen, 0,59-0,79% of phosphorus, 3,92-7,29% of potassium was leached from the fertilizers being applied under the grape plant into the lizimeters.

c) While increasing a weight of the dry mass and nutrient quantity, an extraction by the annual trimming materials rose, too. Extraction under a control (unfertilized) version; nitrogen 7,90-8,16kg/h, phosphorus-3,82-4,35kg/h, potassium-15,97-18,34kg/h, under a version of N90P120K120 these parameters were accordingly: 22,31-23,76; 7,31-7,67; 34,40-37,43kg/h.

d) Extraction by a crop under a control version: nitrogen-7,98-8,99; phosphorus-1,42-1,45kg/h; potassium-6,96-7,41kg/h, under a version of N90P120K120 accordingly: 23,60-23,91; 4,24-4,78; 16,99-20,56kg/h.

e) According to the balance calculations, a positive balance was obtained under all the versions which in mineral fertilizers were applied. A deficit of nitrogen, phosphorus, potassium was observed under the control-unfertilized version.

References

1. Akhundov FQ (1989) Agrochemical concentrated and composite fertilizers. Baku, Elm, pp. 189.
2. Arinushkina EV (1970) Leadership on chemical analyses of soils. M Pub MSU, pp.487.
3. Barlow K, Bond W, Holzapfel B, Smith J, Hilton R (2009) Nitrogen concentrations in soil solution and surface run-off on irrigated vineyards in Australian. Australian Journal of Grape and Research 15(2): 131-143.

4. Dospikhov BA (1985) Method of the field experiment. Agropromprint, pp. 35.
5. Mammadov MI (2014) Balance of nutrients under grape in irrigated light brown (chestnut) soils. Modern agricultural science: current problems and prospects of the century in conditions of globalization. Ganja, Azerbaijan, pp. 206-208.
6. Movsumov ZR (2006) Scientific bases of the efficiency of the plant nutrient and their balance in the system of the crop alternation. Baku Elm, pp. 245.
7. Mammadov MI (2014) Accumulation of nutrients in vegetative organs of vine plants depending on the nutrition conditions of Grey-Brown (chestnut) soils in the Azerbaijan Republic. Agrochemistry Moscow pub Nauka 4: 74-79.
8. Mammadov MI (2009) Entering nitrogen atmosphere precipitations with irrigative waters and extracting from soil with the lizimetre waters. Soil science and agrochemistry works collection Baku, pp. 507-512.
9. Mammadov MI (2011) Entering of phosphorus, potassium the soil with atmospheric and irrigating water. A journal of soil science and agrochemistry Baku 20(1): 457-460.
10. Mammadov MI (2012) Change of the quantity of nitrogen, phosphorus and potassium in lizimetric waters depending on grape plant in the irrigative bright-brown (chestnut) soils. The summary scientific works collection, Baku, pp. 170-174.
11. Mammadov MI (2011) Influence of mineral fertilizers on nutrient accumulation in the grape plant leaves and their extraction by the fallen leaves. Soil science and agrochemistry works collection. Baku, pp. 389-393.
12. Mammadov MI (2013) Role of grape plant in regulation of the balance of the fallen leaves nutrient and trimming materials. Nauka science: Studio Medicine Biology Preemies, Nauka science, Studio18(86): 83-87.
13. Pryanishnikov DN (1965) Selected works TZPub Kolos M, pp. 639.
14. Peterbursky AV (1979) Rotation and balance of the nutrient in agriculture. M Pub of science, pp. 168.
15. Ramos MC, Martines Casanova JA (2006) Nutrient losses by runoff in vineyards of the Mediterranean Alt Penedes region (NE Spain). Agriculture Ecosystems & Environment 113(1-4): 356-363.
16. Shilova EI (1955) Methods of obtaining the soil solution under natural conditions. Soil science 11: 86-90.

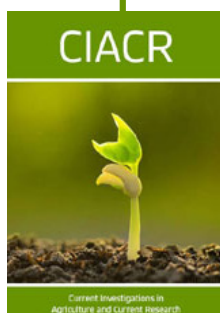


This work is licensed under Creative Commons Attribution 4.0 License

To Submit Your Article Click Here:

[Submit Article](#)

DOI: [10.32474/CIACR.2019.06.000228](https://doi.org/10.32474/CIACR.2019.06.000228)



Current Investigations in Agriculture and Current Research

Assets of Publishing with us

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles