Bulletin UASVM, Horticulture 65(1)/2008
pISSN 1843-5254; eISSN 1843-5394

THE INFLUENCE OF SOIL FERTILIZATION AND MAINTENANCE UPON THE ENERGYCONSUMPTION REQUESTED BY GRAPES PRODUCTION

Maria CONTOMAN

The „Lower Danube" University of Galati
47 Domneasca Street, Galati, cod 800008, mcontoman@ugal.ro

Keywords: energetic balance, soil fertilization, soil maintenance

Abstract: Transformation of solar energy into chemical energy by means of vegetal organisms has always represented one of the most important preoccupations of the contemporary world.
The possibility to rise the light energy conversion coefficient into chemical energy depends on plant endogenous factors, represented by plant genetic abilities to biochemically assimilate CO2 as complex organic compounds using solar energy , on the one hand, and on exogenous factors as well (light, temperature, air CO2 content, humidity, soil mineral substances supply required by plant nutrition).
The bioenergetical interpretation concerning the effect of fertilizers used in plant cultivation refers to a survey that studies the fossil energy consumption required by getting and applying chemical or natural organic fertilizers, on the one hand, and to the light energy stored in the main product which represents an extra cropping as a result of fertilization (Gh. Lixandru & Colab, 1980).

INTRODUCTION

The way of thinking and interpreting biological phenomena differs from economic criteria as , in order to compare and survey, we use much stabler parameterswhich can be expressed in energy units which cannot be influenced by the socio-economical conditions at a given moment. In this context, agriculture, as an economic process, can be envisaged at the energetic dimensions of the entire planetary system.

The research has been done at the Bujoru Viticulture Research Station, Galati Area and its aim was to determine the required energy consumption for obtaining Muscat de Hamburg grapes production , grafted on the Berlandieri x Riparia Kober 5BB mother plant .

MATERIALS AND METHODS

The experimental chart has included the following variable factors:

Soil maintenance –A- with two gradations
- a_0 – black field
- a_1 – erbicide treatment

Soil fertilization –B- with 6 gradations
- b_0 – no fertilization
- b_l - $N_{50}P_{40}K_{60}$
- b_2 - $N_{75}P_{40}K_{60}$
- b_3- $N_{100}P_{40}K_{60}$
- b_4- manure 40 t/ha
- b_5 – green fertilizers.

The experiment was 2x6 type placed in subdivided plots with 3 repetitions. The factors have been combined as to give 12 variants.

The manure was applied at the beginning of the experimental cycle :40 t/ ha.

As green fodder, we used spring vetch (peas 120 + oats 60 kg/ha) sown every two intervals and incorporated into the soil (after mowing and drying) during peas blossoming.The width of the sown band was 1 m wide ,with 2500 m^2 sown yearly for a ha of vine.

Mineral fertilizers have been introduced in the already established doses. As nitrogen fertilizers, we used the ammonium nitrate, with phosphorous , simple superphosphate with/without potassium, potassium salts. Soil herbicidation was done with: Simadon for pre-emergent herbicidation - 8 kg/ha and Roundup during vegetation periods on weeds layers.

RESULTS AND DISCUSSIONS

Energetic efficiency is given by the following indicators:

- energetic basis
- energetic balance
- consumed energy
- produced energy
- energetic balance
- energetic efficiency

In viticulture, the energetic basis is made up of mechanical energy(trctors, machines) and animal and human energy, as well. The unitary expression of the energetic basis is made by changing the energetic resources in Kwh or CP, according to the patterns 1 Kwh = 1.36 CP;

1 ZPA = 1.5 , 1 CP= 1.1 Kwh.

The energetic basis in viticulture undergoes important changes generated by both the techno-scientific development and the energy crisis.

The energy balance represents the totality of the energies consumed within the viticultural eco-system (man-power, raw materials, materials, fuels, equipment, etc) as compared to the energy resulted in „outlets”: grapes, slips or STAS vines.

The consumed energy may be classified into:

Direct active energy – used to produce force, warmth or light. It includes human energy, drive animal energy, fossil energy , electrical energy , thermal , solar or hydraulic.

Indirect active energy – used to produce or extract substances used in production rise and in keeping up the dynamic equilibrium in the viticultural eco-system (chemical fertilizers, pesticides, bio-active substances, amandments).

Passive energy – the energy incorporated in equipment (tractors, machines, irrigation installations, buildings) and in the production of materials (wires, trellises, binding materials).

The consumed energy differs much according to the applied agrotechnical measures, having the greatest weight in phytosanitary protection works + weed killing (33.3%) and in fertilization , as well (32.8%).More differences are to be seen according to the type of consumed energy, the highest values being registered for indirect energy (58.8%), the lowest –for direct energy (4.7%).

The energy we got representss the main energy plus the secondary expressed by a common energetic equivalent (Mcal, Mj , Kwh).

The energetic balance represents the difference between the energy we got (as „outlets” in the viticultural eco-system) and the consumed energy (as „inlets”) (I. Alexandrescu & colab, 1994).

As for the viticultural eco-system at Bujoru, on the Muscat de Hamburg variety, in order to establish the energetic inlets,energetic consumptions generated by the production of chemical fertilizers have been taken into account (25.7 Kwh/1kg n, 5.65 Kwh /1kg P2O5, 4.125 Kwh / 1 kg K2O, the ehergetic equivalent for herbicides, pesticides (30-116.3 Kwh / kg), for manual and mechanized work as well as for the materials required by vine production (wires, trellises, binding materials, etc)

The energetic equivalent of grape sugars is the following: 1 kg of grapes with 160 g sugar/l has got 1.006 Kwh, with 180 g/l, 1.131 g/l, with 200g/l , 1.256 Kwh.

Table 1

The „inkeep” of conventional and human energy in the Bujoru viticultural eco-system (Muscat of Hamburg variety)

Variant	Soil mechanical upkeep		Soil chemical upkeep	
	Yearly energetic comsumption (kwh/t)	Difference to witness (%)	Yearly energetic comsumption (kwh/t)	Difference to witness (%)
Unfertilized	237	100	217	91.6
$N_{50}P_{40}K_{60}$	360	151.8	323	136.3
$N_{75}P_{40}K_{60}$	393	165.8	345	145.5
$N_{100}P_{40}K_{60}$	422	178.0	370	156.1
Manure	411	173.4	379	159.9
Green fodder	276	116.4	253	106.7

The examination of the values reffering to the inkeep of conventional energy within the viticultural eco-system for the production of one ton of grapes shows us that they are minumum when we do not use fertilizers or herbicides or when fertilization is done with green fodder (Table 1).

The energetic efficiency (Table 2) of fertilization varies according to the doses , the type of fertilizers used and by soil and climatic conditions of the years of research.

Vine is a high energy productivity plant, belonging to the category of the high bioconversion capacity of fertilizers in the main product. The accumulation of sugars in the grapes is given by leaf activity and their photosynthesis potential. Fertilization has a positive influence upon leaf photosynthesis activity and of the quantity of assimilates resulted from this process.

For the variants with mineral fertilization , the highest energetic output was obtained when minimum nitrogen doses had been administered on the same background of phosphorous and potassium fertilization ($N_{50}P_{40}K_{60}$).

Nutrient supply in soil also influences the level of energy output in plants[4].

While the highest energetic output is obtained for small fertilizer doses, the highest production levels are obtained for higher doses.

This statement makes us adopt fertilization solutions which must avoid the waste of energy.

For organic fertilization, the green fodder ensures a high energetic output as compared to the manure. Soil preparation through herbicide use led to the decrease of the energetic output, but, at the same time, to the increase of production.

To sum up, we may affirm that in order to have a high energy conversion output from fertilizers, it is necessary to adopt concrete fertilization solutions in accordance with soil supply condition and climatic conditions of the cultivated area.

Table 2

Energy „outlets" within the viticultural eco-system (The energy produced by the Muscat of Hamburg variety)

Variant	Soil mechanical upkeep			Soil chemical upkeep		
	Production t/ha	Energy obtained Kwh/t	Energetic output	Production t/ha	Energy obtained Kwh/t	Energetic output
Unfertilized	11.7	1131	4.77	12.8	1068	3.72
N50P40K60	12.6	1131	3.14	14.3	1068	2.81
N75P40K60	13.2	1068	2.71	15.0	1068	2.63
N100P40K60	13.8	1068	2.53	16.1	1068	2.55
Manure	13.1	1068	2.59	15.0	1068	2.55
Green fodder	11.8	1131	4.09	13.4	1131	4.71

CONCLUSIONS

1. By using mineral fertilizers , the energetic consumptions on product unit rise once with dose increase, the energetic output being lower.
2. When organic fertilizers are being used, the green fodder ensures a high energetic output as compared to the manure.
3. Soil maintenance through weed killing has led to the decrease of the energetic output, but it also increased production.
4. In order to get a high energy conversion output from fertilizers , we must adopt concrete fertilization solutions in accordance with each soil supply and the climatic conditions of the cultivated area.

REFERENCES

1. Davidescu, D., Velicica Davidescu, 1992, Garden Agrochemistry, Academy Publishing House, Bucharest.
2. Eijsakers, H., C. H. Van der Bund, 1988, Interaction between Herbicides and the Soil, Acad. Press, London.
3. Enkera, Ch., M. Chelebiev, 1988, The Effect of Mechanical Cultivation and of Herbicide.
4. Maintenance of the Soil on the Water Physical Properties of Vineyard Soils, Vitis, Vol. 27 (1).
5. Lixandru, Gh., Maria Sârbu, 1980, Bioenergetic Interpretation of Herbicide Effect, Scientific Papers, Vol. 24, 59-64 pp., Agronomy, Jassy.