THE ROLE OF SOME WASTE MATERIAL IN THE NUTRIENT SUPPLY OF ENERGY PLANTS

László Vermes

Corvinus University of Budapest, Faculty of Horticultural Sciences, Villányi út 29-43, 1118 Budapest, Hungary

Nutrient demand of energy plants

Cultivation of energy plants is an imperative need having alternative energy in our present and future time to compensate energy crises. Bioenergy can be used especially for local energy supply, therefore it is expectable that biomass production for obtaining energy will be increased in rural areas. Because the production of energy plants have no longer past in our circumstances, and in this field we are lack in relevant practical experiences, agro-technology of these kind of plants need special attention.

All kind of energy plants – either the soft-stem, annual plants for oil or the hard-stem, arborescent plants for fuel – need a special cultivation technology, with great emphasis on nutrient- as well as water management. In order to provide optimum conditions to the energy plants, their *nutrient demand* – among others – should be determined properly, and this demand should be satisfied during the cultivation period. Thanking to the results of several investigations made in this field, the nutrient demand of most of the energy plants is known, which can be the basis if their *nutrient supply*. The latter depends on partly the nutrient content of the soil, partly the additionally and artificially given nutrients, either in organic or in mineral forms. Taking into account that these kind of plant cultivations are foreseen on soils with rather weak in nutrients and with low productivity, keeping away from the good soils used first of all for food and fodder production, the supplementary nutrient supply in these areas is inevitable necessary. Without this the expected development and yield of the energy plants will be not sufficient on the one hand, and the impoverishment of the soil occur on the other. Both are not desirable at all, therefore should be find the way how could be overcome the problem, which is nevertheless one of the mostly criticized part of the energy plant cultivation in general. According to these negative opinions we gain not too much with the energy plants if we try to put them onto the best soils (excluding form there the food crops) and/or try to supply them with artificially made mineral fertilizers (production of which needs additional energy, too) or applying organic manure on these fields (instead of using the limited available animal manure on the fields of food production). These critics can be removed if we could find other additional sources of nutrient supply for the energy plants, and with the help of those the cultivation of the energy plants can be economical even on soils with secondary or tertiary classification in fertility. The solution can be find by utilizing some well-known waste materials containing both organic and inorganic nutrients, the environmentally safe disposal of which is also necessary, therefore their application can be organized with very low costs indeed. Combination of the two main aims – nutrient supply of the energy plants and utilization of the nutrient containing waste materials – promises a *double advantage* that should not be missed (VERMES and SZENDRÖDY, 1996).

Nutrient content of sewage and wastes

As it is well-known from ancient praxis and from up-to-date research work there are waste materials with rather high content of utilizable constituents. Especially wastes from natural origin are rich in useful elements and compounds potentially usable as

soil conditioning and improving soil fertility, and they also function as a nutrient sources for different kind of plants (SOPPER and KARDOS, 1973). There are many good examples all over the World how these waste materials can be used for nutrient and water supply in different plant cultivations, and based on these experiences further extension of their practical use should be managed, not only for the *utilization* of their nutrient content, but for the safe *disposal* of them as potential pollutants from environmental points of view (VERMES, 2005).
If we have a look on the recycling sequence of nutrients originating from the soil by the plant cultivation, appearing in plant products like food and fodder, and going to use them for consumption (see the figure attached; KUTERA, 1971) we can realize that nutrient-flow is attending to the people through three main ways: 1) either directly by consuming plant products like vegetables, fruits, etc., 2) or indirectly through food industry like manufactured food products, and 3) also indirectly through animal husbandry like converted food products from animal origin. All these forms of products contain considerable amount of *organic matter* and *plant nutrients* like Nitrogen, Phosphorus, Potassium, Calcium and others as macro-nutrients, and several other minerals as essential micro-elements. During the consumption and digestion of these nutrients a relatively small portion is really utilized by the animals and finally the people, and this portion gives them energy and material necessary for life. This portion is only about 10-15 percent in the best case, but the remaining majority will go into the wastes: into the communal sewage and sewage sludge from the people, into the industrial wastes from the food industrial units, and into the manure or liquid manure from the animal husbandry plots. While these material originated from the soil (as it was mentioned earlier) they should be turned back into the soil, where the degradation of the wastes takes place and the elements and compounds can take part again in the building of the new organic plant matter by photosynthesis. This can be realized by the *agricultural utilization of the mentioned wastes* as it was done and still is applied on several parts of the World. If we don't do this, the wastes can pollute the environment considerably, or – to avoid this – they have to be treated with tremendous energy consumption, consequently with high expenditure. The variations of the technology of sewage and waste utilization in agriculture are developed and can be adapted easily for the purpose of nutrient and water supply of energy plants as well (GÁL et al., 1977; VERMES, 1980).

Combining energy plant cultivation with disposal and utilization of waste material is a good solution

The definite proposal is: *the cultivation of energy plants should be organized together with the realization of the disposal and agricultural utilization of wastewaters, sewage sludges and animal manure.* There are already proved methods applied not in case of energy plants, but in other crop production fields and tree plantations for other purposes (VERMES, 2005), giving good examples for successful realization either of satisfactory nutrient and water supply of the cultivated plant stand or of environmentally sound disposal and further natural treatment of the waste material. There are *widely usable technologies* both for liquid form and solid form wastes as follows:

- *for liquid form wastes* (municipal sewage, liquid sludge, food industrial waste water, liquid manure)
  - continuous disposal in deep furrows on tree plantation (most cases on poplar plantation or energy willow-tree plantation with quick cutting periods)
  - periodical disposal in deep furrows on arable land (before ploughing under annual fodder-, industrial or energy crops)
  - periodical disposal by injection into the soil on arable land

- *for solid form wastes* (dewatered sewage sludge, solid phase of manure)
  - periodical distribution on arable land before ploughing and plow into the soil under annual crops (or in rows of a tree plantation)
  - composting of the waste material and periodically utilize it as organic fertilizer on arable land or in tree plantation

Determination of the applied quantity or dosage of the waste material should be made of course according to the real and investigated organic- and nutrient content of the waste and the soil, comparing also to the real demand of the energy plant cultivated. There is an elaborated calculation method for that making the planning procedure easier and more accurate (VERMES, 2005).
Further great advantage of this type of combined technology is that – because it avoid the food-chain using energy plants – it avoid also any potential risk effects on living organisms originating from harmful constituents of the wastes (like heavy metals, toxic elements). It can be stated that this combined method gives a

technically accomplishable,
economic feasible and
ecologically appropriate solution

of this special problem. However it would be worthwhile to make further investigations – e.g. on established pilot plants – for increasing the knowledge and giving evidence of the results in that particular field.

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