

Advance Technologies for Biological Nitrogen Fixation

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One of the most important roles in the Food Security Program of Georgia is attributed to the provision of the population with proteins of plant origin. For Georgia Food safety and food standards are critical global issues. Different illness due to contaminated food and forages are widespread problems in Georgia and all over the world, and it also an important cause of reduced economic productivity. Enhancement of Biological Nitrogen fixation by legumes is one of the biggest global issue for modern agriculture. The original method of inoculation of grain legumes seed, with using German made trans-modernized seed cleaning equipment "Petkus", elaborated and patented by our group of scientists in four countries, enables to get high yield of grain with minimal expenditures on the growing with increasing of biological nitrogen fixation. Using new technologies in farmer's field provides high profit as well as protected environment for future generations.

Georgia experience proves that legume crops like chickpea, faba beans, lentils, and in the latest time – haricot and soybeans have plaid important role for the whole length of our country's 30 century history (less recent two centuries). They were not only a source of food and feeding, but also as a powerful lever in the restructuring of arable lands of Georgia and heightening of the fertility of soils. Our forefathers knew well the high nutritive value of these crops and their positive effect on men and animals, which were used as green mass and straw, including medicinal characteristics.

During many centuries these grain legumes used in crop rotation together with the winter wheat and winter barley in West Georgia, were well accustomed to weather changes, biotic and abiotic stresses like precipitations, frost and other unfavorable climatic conditions, different varieties of illnesses and against all odds which gave almost stable yield. Georgian man understood well the great significance of preservation of soil fertility and duly estimated the effect of biological nitrogen fixed by legumes plants, made on the output of grains to be sown on the same land plot in the following year using only efficient of biological nitrogen and organic fertilizers.

The heightening of efficiency of these crops is based on the original method of inoculation of legumes crop seed with modern steams of *Rizobium* bacteria, selected for each variety of legumes. This method enables us to get maximum harvest of grain, as well as straw, at the least expenditures. At the application of this method the seed prior to its sowing does not require chemical treatment by fungicides, germination rate increases, high expenditures for mineral fertilizers, for *Rizobium* bacteria stems, inoculums, energy carriers for agro-machinery decrease, etc.

The flaw of this method is that it consists of costly mineral nitrogen fertilizers stipulated by agro-technology. It's application results in the growth of self-cost of the obtained production, washing off almost half of these fertilizers and its evaporation, pollution of environment, water reservoirs, and the development of unfavorable process of eurofication. The flaw of this agro-technical method means that the productivity is low, fertilizers and *Rhizotorphin* are consumed in great quantity, and only the third part of it is consumed by plants, the applied agro-technology is of low profitability, mineral nitrogen is washed off and it pollutes the environmental ecology.

Our technology was used in inoculation of legumes plant seeds by the method of formation of pill or pelleting of seed. In the above stated method of making pills of grain crop seeds by the use of mineral fertilizers, manure, the seed is covered by polymer protective film which consists of potassium, phosphorus fertilizers in the amount which are provided by agro-technical norms per one plant, fixed for legumes.

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The offered innovation ensures the growth of crop of legumes plants. For the inoculation of legumes seed by pelleting and obtaining pills, we are using the PETKUS Seed Cleaning and Processing Plant K- 541 with technical capacity data - 2,5 t/h for seed cleaning and 1,8 t/h for seed inoculation (pelleting) to pills after reconstruction (for a while, for inoculation).

The innovation consists in the following: seed of legume crops is moisture first by water, then by 30% solution of polyvinyl alcohol, seed is covered by micro and macro fertilizers. Micro fertilizers are: boric acid, ammonium molybdenate, zinc sulfate and additionally thermally modified cement, and only after this the seed is covered by *Rhizotorphine* – activator of biological nitrogen fixation, selected for each crops and varieties.

By our patented technologies (Georgia State Patents # 1180) seed pills are made as follows (example) : 100 kg conditional seed of lentil is covered by 12,9 liter water, it is kept in a closed vessel for one hour up to complete consumption of that water; then seed is taken from the vessel (seed surface must be dry), is put into rotating drum, is added 0,941 l of 30% polyvinyl alcohol water solution and is mixed for 15 minutes, for equal wetting, it is added by boric acid – 0,0134 kg, zinc sulfate– 0,0087 kg, ammonium molybdenate – 0,024 kg, cement –4,3068 kg and *Rhizotorphine* –0,3529 kg and is mixed for final fixation of component mixture to the seed, for what 10-15 minutes are sufficient. The obtained pill is dried through warm air flood (30-35°C) up to drying the seed surface. Then the seed is rinsed in chloroform, 3% solution of polycarbonate and is dried anew in a flush of warm air (30-35°C) for 10-15 minutes up to complete evaporation of the solvent and the appearance of a film on the seed pills.

Inoculation of legume crops seeds by the method of pelleting of seed, ensures the great economy of micro and macro mineral fertilizers as well as *Rizobium bacteria* material, protection of environment from its pollution, ecologically pure and safe production of legumes and later on the same land plots, high output of other crops, which are sown after those legumes and favorably use biological nitrogen fixed by legume crops.

Intensive accumulation of biological nitrogen in soil results in heightening of its fertility and growth of output of legumes by 40% and that of legume grasses by 57%.

Table

Version/ variety	Yield, t/ha	Growth of yield comp. control	grain price per ton, euro	Total value of production harvested per ha, euro		Expe nditur es made for growi ng	Net inco me, euro	fixed nitro gen, kg/ha	profit, %
				total	extr a				
Lentil grown by standard agro- technology (control)	1,75	–	400	700	–	274.5	425.4	23,7	155
Lentil, grown by the method of seed pilling and relevant agro- technology	2.45	0.72	400	988	288	183.4	804.5	51,6	439

Table presents the data of economical efficiency of above-described method, clearly prove its profitableness. Application of the technologies elaborated in grain legumes crop farm economies, irrespective their small territories, proved that traditional technologies used in rearing of these cultures can not compete, even slightly, with scientific achievements, especially if we consider the indices such as net income and environment protection value.

Especially very well were the matters in farm economies distributed in the arid zone of East Georgia, in last 2008-2009 vegetation year (as a winter crops) in Mtskheta and Dedoplistskaro

districts, where we planted those crops using technology of seed pelleting by kind financial and scientific assistances of USDA and University of Maryland.

In these regions, on the land plots of farmers' households, at about 3,8 metric t/ha chickpea, 2,7 t/ha lentils, and 4,2 t/ha faba bean was obtained on the small trials, while in West Georgia, in the humid zone (Lanchkhuti and Samtredia districts) soybeans in pilot plots reached 2,5 ton per ha without mineral fertilizers. The fact is to be emphasized that advantage of elaborated technologies were so apparent and reliable that they found great popularity among farmers and local governmental authorities during field days.

Joint international scientific collective groups must be created in the nearest future, which will exchange the results of scientific-research achievements, will intensify the practice of exchange training, take active part in international meetings of scientists, symposia and conferences of European countries.

Heightening of efficiency of the results of research works is a demand of contemporary and it must be supported by creation of necessary terms for strengthening of private farm economies not only in Georgia, but also EU countries, USA, est. This will become a foundation for successful implementation of the Food Security and Safety Programs of our continent and world at all.

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