RESULTS OF POTATOE FIELD PRODUCTION USING NEW GRANULE FERTILIZERS AND AMELIORATION CONTAINING SEA SAPROPELS

РЕЗУЛТАТИ ОТ ИЗПОЛЗВАНЕТО НА НОВИ ГРАНУЛИРАНИ ТОРОВИ СРЕДСТВА И МЕЛИОРАНТИ, СЪДЪРЖАЩИ МОРСКИ САПРОПЕЛИ ПРИ ПОЛСКО ПРОИЗВОДСТВО НА КАРТОФИ

Zhivko TERZIEV, H. KIRCHEV, N. SEMKOVA

Agricultural University, Plovdiv, Bulgaria
Corresponding author: Zhivko TERZIEV, e-mail: terziev@au-plovdiv.bg

***Abstract**: A field experiment on semi-early Dutch variety of potatoes Agria was carried on the experimental field of Plant growing department of Agriculture University - Plovdiv during the period 2002-2004. A standard method of 4 repetitions on plots of 50 m^2 was used to determine the influence of new granule fertilizers and Black sea sapropel on tuber yield and starch content. Increasing of 9.15-15.1% of tuber yield was determined and increasing of the starch content with 0.25-1.54 points.*

***Резюме**: В УОВБ на Аграрен университет – Пловдив през периода 2002-2004 г. беше залаган полски опит със средно ранния холандски сорт картофи „Агрия" по стандартен метод в 4 повторения с големина на реколтната парцела 50 m^2. Изпитвано е влиянието на нови гранулирани средства и мелиоранти, съдържащи морски сапропели върху добивът на клубени и съдържанието на скорбяла в тях. Беше установено увеличаване на добива клубени с 9.15-15.1% и повишение на скорбелното съдържание с 0.25-1.54 пункта.*

***Key words:** potatoes, Black sea sapropels, granule fertilizers, tuber yield, starch content*
***Ключови думи:** картофи, Черноморски сапропели, гранулирани торове, добив клубени, скорбялно съдържание*

INTRODUCTION

Chemical fertilizers with sour characteristics like ammonium nitrate, ammonium sulphite, calcium nitrate etc. not only progressively turn soil with insufficient buffer properties sour but also deteriorate its structure. In that respect such fertilization results in sharp reducing of yield as well as in accumulating dangerous for health nitrates.

To improve thus deteriorated agro-biological properties of soil research was conducted using Black sea sapropel and melioration (Dimitrov and Velev, 1988; Dimitrov et al., 1992; Dimitrov and Nikolov, 1992; Cholakov and Nikolov, 2003). According to the authors when using this method they act as a buffer reducing the sourness of soil to neutral, improving both the quality and quantity of humus contained and increasing the resistance to stress factors of tomato seedlings as well as accelerating the rizogenesis and increasing their growth.

It is a well known fact that potatoes (of semi-early and late field production) can be treated with high fertilizer norms but because of the sharp decrease of the expected effect as well as of the negative ecological influence on soil it is recommended such high norms to be used in parts – before planting and during the vegetation (Yankov et al., 2002).

The aim of this research is by means of using new granule fertilizers and melioration to achieve maximum effect.

MATERIAL AND METHODS

A field experiment on semi-early Dutch variety of potatoes Agria was carried out on the experimental field of Agricultural University – Plovdiv during the period 2002 -2004. The aim of the experiment was to determine the influence on the yield and on the quality of tuber production of 30 kg.da^{-1} N granule fertilizers applied only once before planting as compared with the commonly accepted method of fertilizing three times – once before planting and two times during the vegetation. A standard method of four repetitions on plots of 50 m^2 was used after *Triticum aestivum* L. as predecessor, cultivated using the commonly accepted for the country technology. Herbicide Zenkor was used for weed control and Regent for Colorado potato beetle. Three irrigations of 60m^3 each were done during vegetation.

The experiment consisted of the following variants: Control variant – fertilizing with ammonium nitrate – 30 kg.da^{-1} N applied three times in equal amounts before planting and two times during vegetation; Variant 1 – 30 kg.da^{-1} N, applied only once in the form of granules with diameter of 1.8 – 1.0 cm, containing ammonium nitrate, kaolin as inert filler and active supplement of Black sea sapropels, acting as buffer for pH. The granules are formulated with the help of 2% solution of modified polyvinyl alcohol, acting as adhesive material with lower solubility. After drying the granules are overlaid with polymer layer by dipping into 4% solution of MPA. Variant 2 – the granules used in this variant contain the same ingredients as in Variant 1.The only difference is that none modified polyvinyl alcohol was used as adhesive material and polyvinyl layer (PVA). The macro-granules were prepared by the Chemistry Department of Agricultural University – Plovdiv.

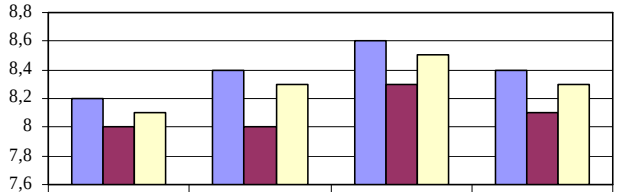
To achieve the aims of the experiment the following indexes were determined: number of tubers from one plant, g; tuber yield, kg.da^{-1}; relative density of the tubers; dry matter, %; starch value, %; starch %.

The data of the yield elements and tuber yield by year are mathematically processed using the method of differences. The qualitative indices are determined by the relative density of tubers (Terziev et al., 1999).

RESULTS AND DISCUSSION

Figure 1 represents the number of cultivated tubers from one plant by year and on the average for the period of the research.

A tendency of increased number of tubers by year and on the average can be seen in Variant 1 and Variant 2. During 2002 this tendency is not so strongly expressed. The differences during the three years are not mathematically proved (Table 1).



	2002	2003	2004	Average
Variant 1	8,2	8,4	8,6	8,4
Control	8	8	8,3	8,1
Variant 2	8,1	8,3	8,5	8,3

Figure 1. Number of cultivated tubers from one plant by year and on the average for the period.

Table 1

Data from the mathematical processing of results, represented in Fig 1.

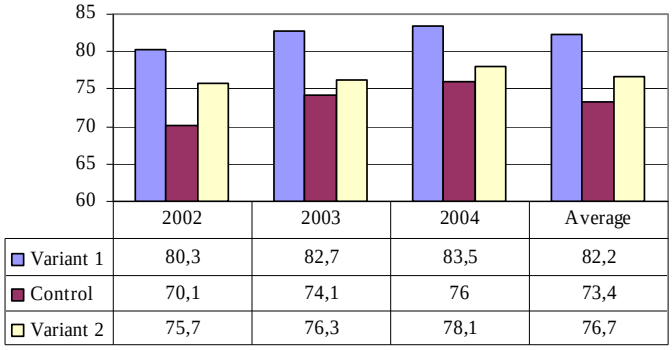
Variants	2002		2003		2004	
	x±Sx	t_e	x±Sx	t_e	x±Sx	t_e
Variant 1	8.2±0.17	0.24	8.4±0.19	1.82	8.6±0.12	1.88
Control	8.0±0.8	-	8.0±0.11	-	8.3±0.10	-
Variant 2	8.1±0.24	0.12	8.3±0.13	1.76	8.5±0.09	1.54

P – 5% - t_t =1.98; P – 1% - t_t = 2.63; P – 0.1% - t_t = 3.39; n=100

Data in Figure 2 shows that the plants from Variant 1 form tubers with higher mass as compared with the ones from the Control variant and Variant 2. The analysis shows that during the period of the experiment the mass of one tuber in Variant 1 is 83.5 ±1.79 compared with 76 ±1.2 and 71.1 ±1.5g. The determined differences in favour of Variant 1 during the three years of the experiment are mathematically confirmed. (Table 2).

The tendency of higher number of tubers and a higher average mass (mathematically proved) in Variant 1 is good precondition for realization and for higher mass of tubers, cultivated in this variant.

As it can be seen in Figure 3 the average mass of tubers for the period is 682.1 g compared with 605.6 and 674 g respectively for the Control variant and Variant 2. The represented differences in the two variants compared with the Control Variant are mathematically proved (except for Variant 2 – 2002) (Table 3).



	2002	2003	2004	Average
Variant 1	80,3	82,7	83,5	82,2
Control	70,1	74,1	76	73,4
Variant 2	75,7	76,3	78,1	76,7

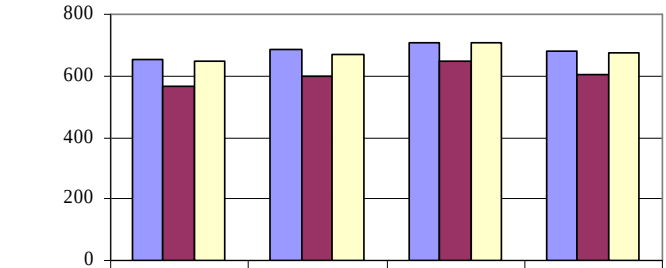
Figure 2. Average mass of 1 tuber – by year and on the average for the period.

Table 2

Data from the mathematical processing of the results, represented in Fig. 2.

Variants	2002		2003		2004	
	x±Sx	t_e	x±Sx	t_e	x±Sx	t_e
Variant 1	80.3±1.3	6.67	82.7±1.1	5.77	83.5±1.7	3.61
Control	70.1±0.8	-	74.1±1.0	-	76±1.2	-
Variant 2	75.7±0.9	4.67	76.3±1.3	1.09	78.1±1.5	0.99

P – 5% - t_t = 1.98; P – 1% - t_t = 2.63; P – 0.1% - t_t = 3.39; n=100



	2002	2003	2004	Average
Variant 1	650,6	686,6	709,1	682,1
Control	568	600,5	648,3	605,6
Variant 2	648,5	668,4	707,5	674,8

Figure 3. Average mass of tubers from 1 plant – by year and on the average for the period.

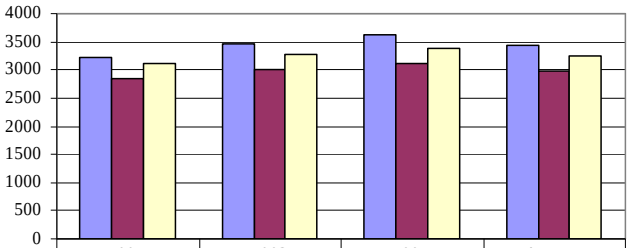
Table 3

Data from the mathematical processing of the results, represented in Fig.3

Variants	2002		2003		2004	
	x±Sx	t_e	x±Sx	t_e	x±Sx	t_e
Variant 1	650.6±10.8	5.12	686.6±11.3	5.44	709.1±13.1	3.83
Control	568±12.0	-	600.5±11.1	-	648.3±9.0	-
Variant 2	648±9.7	1.30	668.4±9.5	4.65	707.5±11.6	4.03

P – 5% - t_t - 1.98; P – 1% - t_t - 2.63; P – 0.1% - t_t - 3.39; n=100

The most significant index is the tuber yield. It is logically to assume that its values are in correlation with its forming elements, namely: the number of tubers from 1 plant; the average mass of formed tubers and the mass of tubers from 1 plant.



	2002	2003	2004	Average
Variant 1	3224	3451	3624	3433
Control	2840	3007	3109	2985
Variant 2	3104	3281	3389	3258

Figure 4. Tuber yield – by year and on the average for the period.

Table 4

Data from the mathematical processing of the results, represented in Fig. 4

Years	Variant 1			Control			Variant 2		
	x±Sx	±D	t_e	x±Sx	±D	t_e	x±Sx	±D	t_e
2002 г.	3224±54.2	+384	6.20	2840±30.0	-	-	3104±25.9	+264	6.66
2003 г.	3451±32.7	+444	8.47	3007±41.0	-	-	3281±48.3	+274	4.32
2004 г.	3624±52.4	+515	6.63	3109±57.3	-	-	3389±49.9	+280	3.69
Average, $kg.da^{-1}$,%	3433 115.01			2985 100.00			3258 109.15		

P – 5% - t_t= 3.18; P – 1% - t_t =3.84; P – 0.1% - t_t =12.94; n=4

Regarding this index the total analysis of data in Figure 4 shows the yield precedence of Variant 1 in comparison with the Control variant and Variant 2. Compared with the Control Variant by year (2002, 2003 and 2004) more tubers are cultivated from this variant – respectively: 384; 444 and 515 $kg.da^{-1}$. It is necessary to lay special emphasis on the precise mathematical proof of the represented differences. (Table 4). A similar but less strongly expressed effect can be seen when Variant 2 is compared with the Control Variant. The yield precedence here is in the higher yield, respectively: 264, 274 and 280 $kg.da^{-1}$.

The starch content of tubers is of great significance for their quality. According to the data in Table 5 on the average for the period of the experiment the tubers from the two variants have higher starch content. Compared with 15.2% in the Control variant the values for the two variants are respectively 16.74 and 15.45%.

Table 5

Relative density, dry matter (%), starch value (%), starch (%) - on the average for the period of the experiment.

Variants	Relative density	Dry matter (%)	Starch value (%)	Starch (%)	Starch ± to Control
Variant 1	1.1001	23.987	18.235	16.74	+1.54
Control	1.0929	22.447	16.695	15.20	-
Variant 2	1.0914	22.703	16.951	15.45	+0.25

CONCLUSIONS

Application of granule fertilizers, prepared with polyvinyl alcohol (PVA, PVA – M) and Black sea sapropels is an effective agricultural method resulting in:

1. Increasing of tuber yield of potato field production with 9.15 – 15.1% in comparison with the commonly accepted technology of fertilizing with high nitrogen norms. The effect is in the higher number of tubers (under the application of PVA –M), the higher mass of each average tuber as well as in cultivating a higher quality (mass) of tubers from each plant.
2. Increasing the starch content of tubers with 0.25 – 1.54 points.

LITERATURE

1. DIMITROV P., VELEV V.1988. *Potentialities of Using Deep Sapropel Slime of the Black Sea for Agrobiological and Industrial Purposes*, Oceanology, book 17, 92 – 95, Sofia.
2. DIMITROV P., SOLAKOV D., DIMITROV D. 1992. *Potentialities of Using the Black sea Deeowater Organic-mineral Sediments as Natural Ecological Fertilizer and for Recultivating of Soils with Deteriorated Agrobiological Content*, Balkan conference on ecology, 26-29.05, V. Turnovo, Scientific reports
3. DIMITROV P., NIKOLOV N. 1992. *Melioration Content for Soils with Deteriorated Agrobiological Characteristics and for Fertilizing of Substrata*, Patent Rb, Reg.N104106/25.01
4. TERZIEV Z., B YANKOV, HR YANCHEVA, R IVANOVA, T. GEORGIEVA, I. YANCHEV, T. KOLEV. 1999, *Manual of Plant growing Practice*, Videnov & Son, Sofia
5. CHOLAKOV D., NIKOLOV N. 2003. *Improving of the Results of Tomato Cultivations in None Heated Plastic Conservatories Using Sea Sapropels*, Scientific Reports, International Scientific Conference '50 years Forestry University' page 277-281 Sofia.
6. YANKOV B., MOSKOV G., TERZIEV Z., YANCHEVA HR., 2002. *Plant growing*, Academic publication of Agricultural University – Plovdiv.