

IDENTIFYING THE PHYSICAL PROPERTIES OF THE SOIL USING PROPER SOIL SOFTWARE

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Abstract: The main physical soil properties are considered highly important for soil fertility. Measuring only 4 indicators taken from the soil samples and by using physical equations can determine valuable results for the soil physical properties. To facilitate the analysis a develop software could help.

KEYWORDS: SOI PHYSICAL PROPERTIES, SOFTWARE PRODUCT

1. Introduction

Purpose and environment for development

The physical properties of the soil can be identified in several ways. In this case, we carry out the identification of the whole range of physical properties by introducing four indexes – container volume, wet soil mass, dry soil mass and volume of the hard soil.

The application has been designed for:

- Registering the farmers and their fields, which they committed for the research trials;
- Identifying the physical properties of the soil at different depths;
- The graphic presentation of the data after processing the input data;
- Creating a database.
Environment for developing the application

The application has been developed on Microsoft Access 2010. Visual Basic For Application (VBA) was the language used for developing the forms and references .

2. General information

Working with the application we use:

Forms – the forms are used to support up-to-date information in the database. They provide opportunity to enter, change or delete records in the tables. For each form, where necessary, drop-down menus have been created for selecting the allowed values. When wrong data have been entered, a message is visualised in a window, showing where and why the error has occurred, and an opportunity is provided for making a change.

Graphs – graphic presentation of set and/or calculated data.

References – using references, the information stored in one or more tables in the database can be viewed and printed.

User guide

Main form of the application

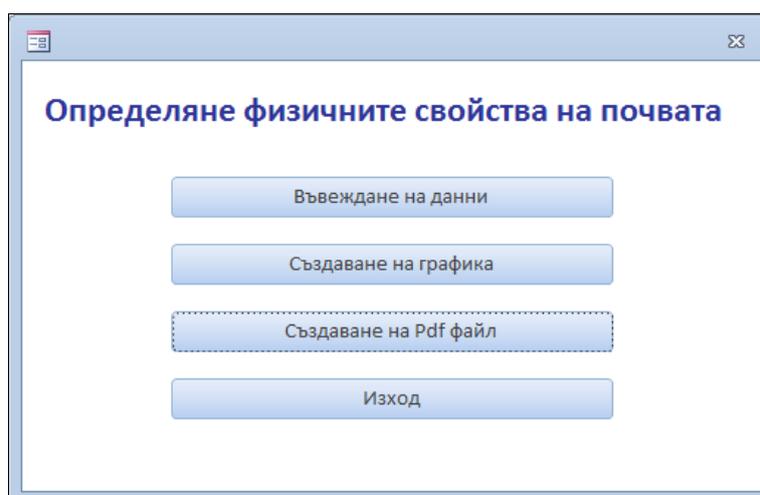


Fig.1. Main form

The main form of the application is visualised immediately after a PropeSoil.accdb file is opened (fig.1). Using the control buttons, different execution actions can be selected such as forms for supporting the information in the tables, references and graphs based on the data stored, or creating a pdf file. For some of the forms there are extra buttons for choice of action, so as to facilitate the work of the user.

When the Escape button is pressed, the application stops working and MS Access is closed.

For easier use of the application, the actions executed are organised by themes. Choosing any of the buttons, a form is activated within the main form, which contains buttons for executing specific actions (forms or reports). Through each of the forms, the records saved in the tables can be added, erased or changed by pressing control buttons.

Data input (fig.2)

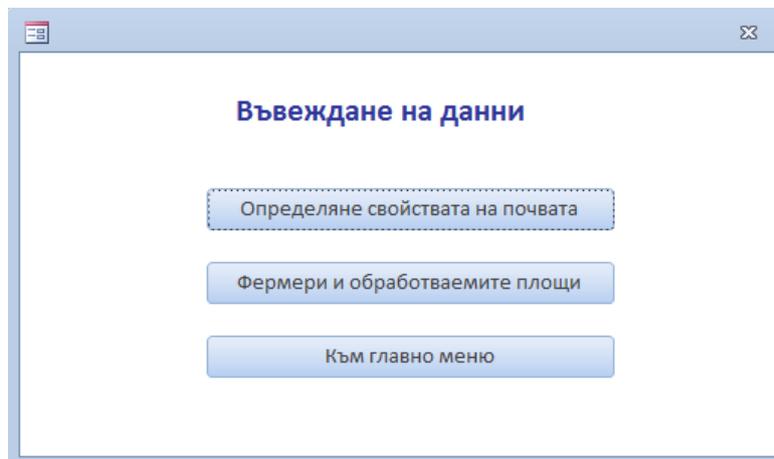


Fig.2. Data input

For each form, the following rules have been applied for data input:

- Each of the number fields is checked and an error message is displayed when a field is incorrect;
- There is a command button "Help", which indicates the way to fill in the fields and the restrictions that have been set for them;
- For some of the fields there are drop-down menus of values for selection by user;
- Command buttons for adding, saving, deleting, as well as viewing and printing;
- Command buttons for reviewing and searching for records;
- Command buttons for escape from the respective form.

Farmers and arable fields (fig.3)– first, the user assigns in the left-hand sub-tab a farmer's name and the number of fields this farmer cultivates while in the right one - the name of the field and the size of the areas. The software assigns a code to the farmer.

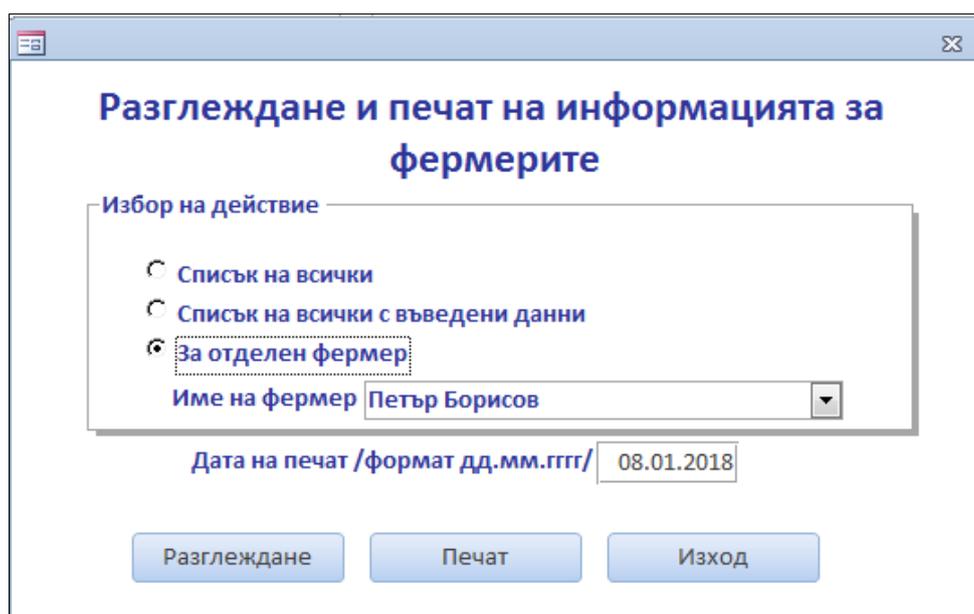


Fig. 3. Farmers and arable fields

Viewing and printing (fig.4) – the user sets a mandatory date (a calendar is selected by positioning the cursor on the field "Date of printing") and he can choose what data to print and view:

- Comprehensive list – the data of all registered farmers, whether they have fields assigned for cultivation or not, are displayed;
- List of all farmers with data input – only the data of those registered farmers, who have areas for cultivation assigned;
- A single farmer –the name of the farmer is selected from a drop-down menu.

Фермери и техните обработваеми полета			
Име на фермер	Брой полета	Име на поле	Декари
Петър Борисов	8		
		b1	100
		b2	122
		b3	50
		b4	76
		b5	225
		b6	95
		b7	80
	b8	150	
Обща обработваема площ			898,00

Fig. 4. Viewing and printing

Identifying the physical properties of the soil (fig.5) – the name of a farmer and the number/name of a field are selected from drop-down menus of values, then the sequence number of the trial is set for the respective field of the farmer (no double numbers for the trial in the respective field are allowed) and the date (selected from a calendar to the right of the tab). Data on the depths measured are entered only in the first four fields (they can be set for only some or for all depths). When the values are set and the button “Calculate and save” is selected, the values are calculated by the software, using predefined formulas.

The command buttons in the section “Review all records and search” are used for reviewing all the records or searching.

Working with the equipment:

The equipment needed for the field measuring is:

- Metal container with openings on both sides and plastic caps; hammer; wooden bar, spade and knife.

A vertical walled trench is excavated at a certain depth.

The depth is measured and recorded. The metal container is put on

the wall and with the help of the wooden bar and the hammer is driven into the soil. The soil on both sides of the container is flattened and the plastic caps are placed.

The volume of the container is measured and recorded. Since it is a constant value, it is measured only once.

The mass of the container, filled with wet soil, is measured and recorded.

The metal container is placed into a dryer and the soil is dried. The mass of the dried soil is measured and recorded.

One of the caps is placed and water is poured into the container until all the pores are filled. The volume of the water absorbed by the soil is measured and then subtracted from the total volume of the container. The difference shows the volume of the hard soil. If the soil is well-structured, the hard particles are about 50 %. The data measured are filled in the table – fig. 1 (the text in red). Then you click on the button “Calculate and save” and the physical properties of the soil are automatically determined.

Определяне физичните свойства на почвата						
Име на фермер		Петър Борисов		Номер/име на поле		b1
Номер на изследване		2		Дата на изследването		21.07.2016
Физически свойства на почвата	Означение	Определени стойности при измерени дълбочини			Ориентировъчни стойности	Размерност
		0 - 20 см	20 - 40 см	40 - 60 см		
ДАНИ ЗА ВЪВЕЖДАНЕ						
Обем на контейнера за вземане на пробите	(Vt)	1000	1000		...	cm ³
Маса на влажна почва	(Mw)	800	759		...	g
Маса на суха почва	(Ms)	500	500		...	g
Обем на твърдата фаза на почвата (обем на частиците)	(Vs)	300	300		...	cm ³
ИЗЧИСЛЕНИ ПОКАЗАТЕЛИ						
Плътността на твърдата фаза на почвата	(ps)	1,67	1,67		2,6 - 2,8	g/cm ³ ; t/m ³
Обемна плътност на суха почва	(pb)	0,50	0,50		0,7 - 1,8	g/cm ³ ; t/m ³
Обемна плътност на влажна почва	(pb')	0,80	0,76		1 - 2,	g/cm ³ ; t/m ³
Относителна плътност на почвата	(Gs)	1,67	1,67		2,6 - 2,8	g/cm ³ ; t/m ³
Специфичен обем на суха почва	(Vb)	2,00	2,00		0,5 - 1	m ³ /t
Порьозност, (f_t)	(ft)	0,70	0,70		0,3 - 0,7	m ³ /m ³
Обем на порите, запълнени с въздух	(fa)	0,30	0,40		0 - ft	m ³ /m ³
Отношение на празните пространства	(e)	2,33	2,33		0,4 - 2,2	дробно число
Въздушно отношение	(α)	1,00	1,32		0 - 1	безразмерна
Гравиметрично съдържание на вода	(w)	0,60	0,52		0 - 0,3	Kg/kg (%)
Обемно съдържание на вода	(θ)	0,30	0,26		0 - 0,7	m ³ /m ³
Съотношение на течната фаза	(θp)	1,00	0,86		0 - 1	безразмерна
Обем на порите, запълнени с вода	(Vw)	700,00	604,33		200 - 400	cm ³ /cm ³
Общ обем на порите	(Vf)	700,00	700,00		200 - 500	cm ³ /cm ³
Степен на насищане с вода	(s)	1,00	0,86		0 - 1	дробно число
Обем на газовете в почвата	(Vg)	300,00	395,67		150 - 250	cm ³ /cm ³

Обходване на всички записи и търсене

Първи запис Следващ запис Предходен запис Последен запис Търсене

Добавяне Изчисляване и запазване Изтриване Разглеждане и печат Изход

Fig. 5. Table with data input and results obtained

When you click on "View and print" (fig.6), a form comes out to determine whether a list of all information saved should be made, or only one for the calculations made for a single farmer. The

user should enter a mandatory date of the viewing and printing (fig.7).

Fig. 6. View and print

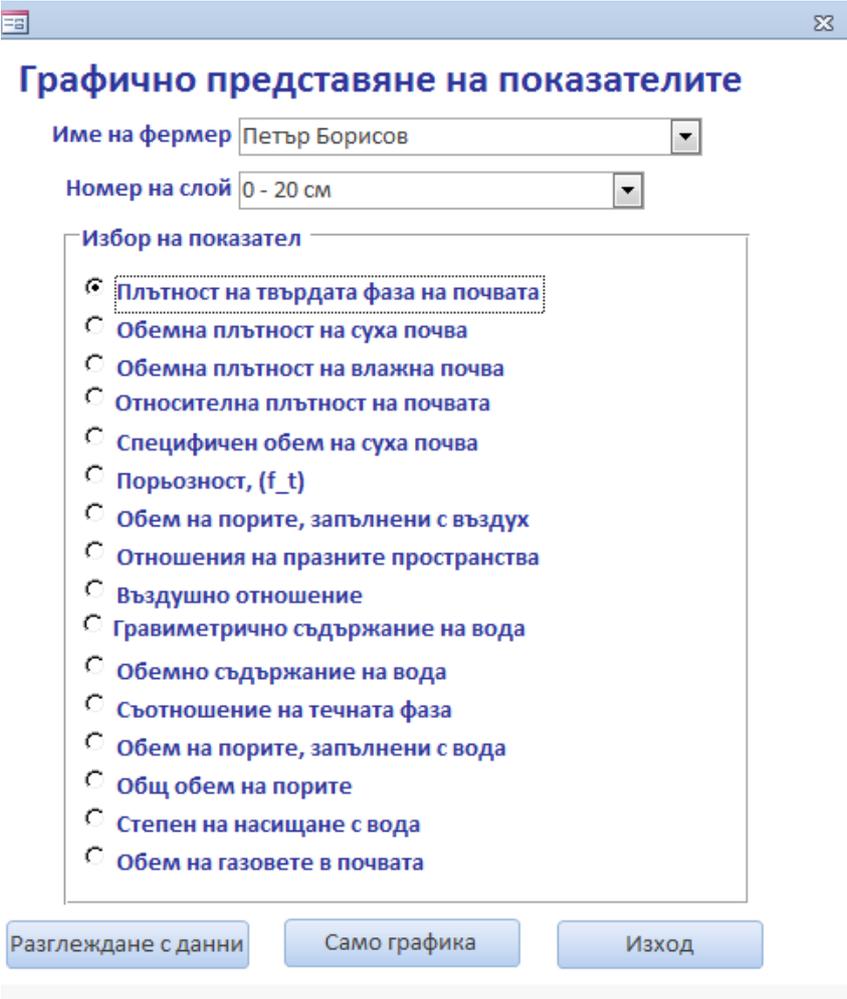
Определяне физичните свойства на почвата			
Име на фермер: Петър Борисов			
Номер/име на поле: b1			
Номер на изследване: 2			
Дата на изследване: 21.07.2016			
Физически свойства на почвата	Определени стойности при измерени дълбочини		
	0 - 20 см	20 - 40 см	40 - 60 см
Обем на контейнера за вземане на пробите	1000	1000	
Маса на влажна почва	800	759	
Маса на суха почва	500	500	
Обем на твърдата фаза на почвата (обем на частиците)	300	300	
Плътността на твърдата фаза на почвата	1,67	1,67	
Обемна плътност на суха почва	0,50	0,50	
Обемна плътност на влажна почва	0,80	0,76	
Относителна плътност на почвата	1,67	1,67	
Специфичен обем на суха почва	2,00	2,00	
Порьозност, (f _t)	0,70	0,70	
Обем на порите, запълнени с въздух	0,30	0,40	
Отношение на празните пространства	2,33	2,33	
Въздушно отношение	1,00	1,32	
Гравиметрично съдържание на вода	0,60	0,52	
Обемно съдържание на вода	0,30	0,26	
Съотношение на течната фаза	1,00	0,86	
Обем на порите, запълнени с вода	700,00	604,33	
Общ обем на порите	700,00	700,00	
Степен на насищане с вода	1,00	0,86	
Обем на газовете в почвата	300,00	395,67	

Fig. 7. Viewing and printing

Graphic presentation of indexes

After determining the physical properties of the soil, the user can present the indexes calculated for the trials registered at different depths in a graph (fig.8). This can be done by selecting the command button „Graphic generation“ from the main form of the application. A form is selected and from drop-down menus for the name of the farmer and number of soil layer (they are mandatory) it is determined which of the indexes will be shown as a graph (you can do it for one index only). Two versions are possible:

- „Viewing with data“ (fig.9) – generating of a graph and the data used for its generation. All data on the registered trials can be viewed by scrolling.
- „Graph only“ (fig.10) – only the graph can be viewed without the data, and it can also be printed by pressing the “Print” button. At the top of every column the respective values calculated by the software are displayed.



Графично представяне на показателите

Име на фермер: Петър Борисов

Номер на слой: 0 - 20 см

Избор на показател:

- Плътност на твърдата фаза на почвата
- Обемна плътност на суха почва
- Обемна плътност на влажна почва
- Относителна плътност на почвата
- Специфичен обем на суха почва
- Порьозност, (f_t)
- Обем на порите, запълнени с въздух
- Отношения на празните пространства
- Въздушно отношение
- Гравиметрично съдържание на вода
- Обемно съдържание на вода
- Съотношение на течната фаза
- Обем на порите, запълнени с вода
- Общ обем на порите
- Степен на насищане с вода
- Обем на газовете в почвата

Разглеждане с данни Само графика Изход

Fig.8. Graphic presentation of indexes

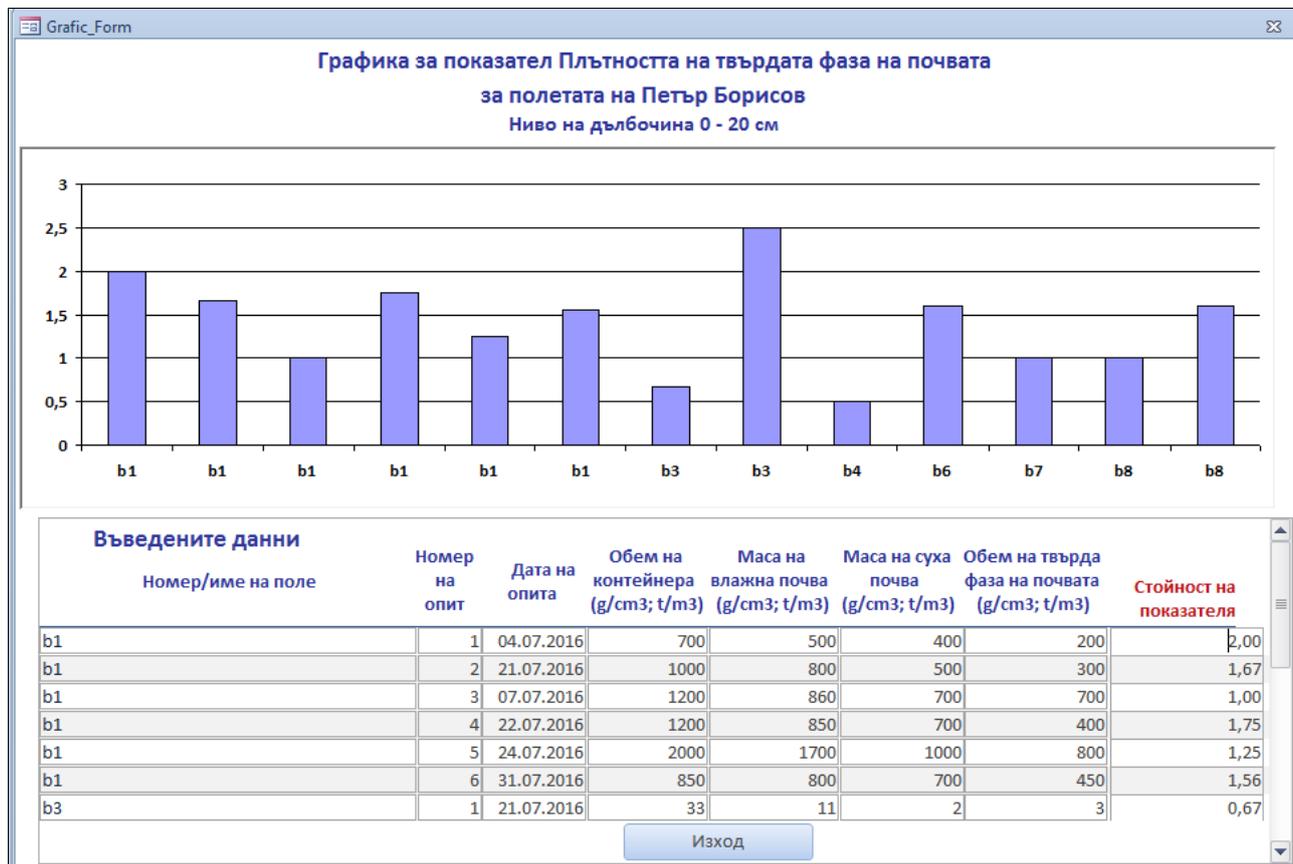


Fig. 9. Graphs with data

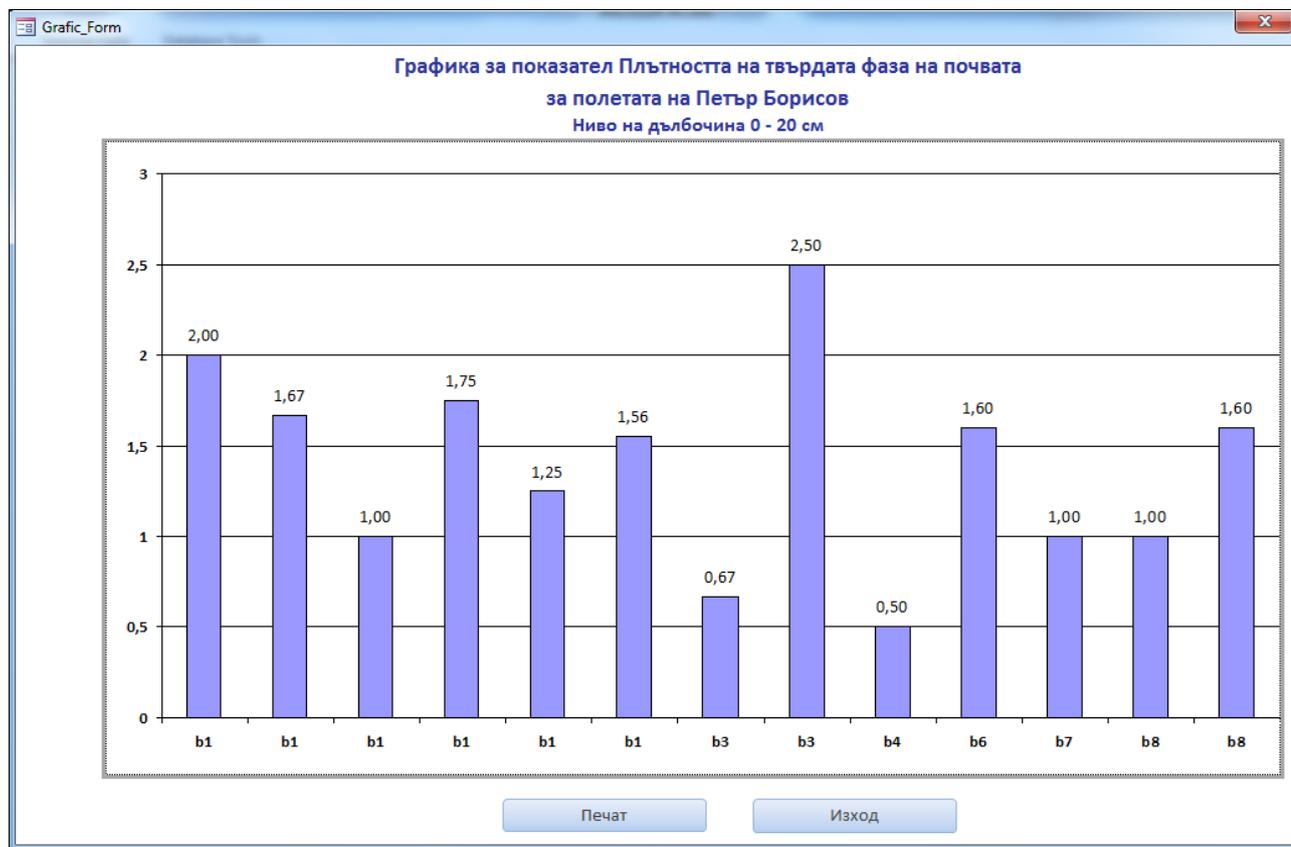


Fig. 10. Graphs only

Fig. 11. Creation of pdf file

For each of the registered farmers and calculations made for the physical properties of the soil in his arable land a pdf file can be generated (fig.11). After the name of the farmer is selected from a drop-down menu, the file is named (you can also determine where it should be saved – directory and subdirectory), the date of generation is set, you click on the command button „Generate a pdf file“, and the newly generated file is opened for viewing in Adobe Reader.

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