

Development of a Mapping Program for Variable Rate Application

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Abstract: Negative effects of pesticide and fertiliser on human health are well known. In this research; a computer software was developed to control a variable rate electronic controller for getting maximum yield by using optimum fertiliser and preventing excess fertiliser usage in agriculture. In the study, a DGPS (Trimble AgGPS 132), centrifugal fertiliser spreader with two discs, and a variable rate controller were used as materials. The variable rate controller system consist of two step motors, a PIC card witch control those step motors, and mechanical part
Flow chart was developed after determination of the software functions. Microsoft Visual Basic as Programming language and Microsoft Access as a database by using developed flow chat. Laboratory tests of the developed software were realized.

The developed software was named as Variable Rate Fertiliser Application (DEMİGUY PRO V 1.0). According to the laboratory tests, the results of the creating of application map and changing of the fertilization rate by using real time kinematics coordinates were successfully by the developed software.

Key words: Variable rate, fertiliser application, GPS, application map, precision agriculture, variable rate application

Değişken Miktarlı Uygulama için Haritalama Programı Geliştirilmesi

Özet: Gübrelere ve ilaçların çevre ve insan sağlığına olumsuz etkileri bilinmektedir. Bu araştırmada; tarımda optimum gübre kullanımı ile maksimum verim elde etmek ve gereksiz gübre kullanımını önlemek amacıyla değişken düzeyli uygulama yapabilen elektronik bir sistemi kontrol eden bir bilgisayar programı geliştirilmiştir.

Çalışmada konum belirleme sistemi (Trimble AgGPS 132), çift diskli santrifüj gübre dağıtma makinesi ve değişken düzeyli kontrol sistemi kullanılmıştır. Değişken düzeyli kontrol sistemi 2 adet step motor, bu motorları kontrol eden bir adet PIC kartı ve mekanik kısımdan oluşmaktadır.

Programın görevlerinin neler olacağı saptandıktan sonra iş akış şeması oluşturulmuştur. İş akış şeması üzerinden hareketle Microsoft Visual Basic programlama dili olarak ve Microsoft Access'de veritabanı olarak araştırmada kullanılmıştır. Geliştirilen programın laboratuvar denemeleri yapılmıştır. Yapılan çalışmalar sonucunda geliştirilen program Değişken Miktarlı Gübre Uygulama Programı (DEMİGUY PRO V 1.0) olarak adlandırılmıştır. Uygulama haritasının oluşturulması ve gerçek zamanlı koordinatları kullanarak gübre normunun ayarlanması program tarafından başarılı olarak gerçekleştirilmiştir.

Anahtar kelimeler: Değişken miktarlı, gübre uygulama, GPS, uygulama haritası, hassas tarım, değişken düzeyli uygulama

INTRODUCTION

Precision agriculture used in different terms in the world is called the system that was created as a result of calculations made using strategies that take full advantage on the basis of control, electronics, and data. Field Specific Agriculture, Field Specific Management, Computer Aided Agriculture, Prescribed

Agriculture, Variable Rational Application Entry, Point Agriculture can be considered among other expressions of precision agriculture. The components of precision agriculture are global positioning systems, geographic information systems, variable rate application and remote sensing (Vatandas et al. 2005).

Fertilizer application in agricultural production is one of the most important tasks. Fertilizer is equally applied to the entire field regardless of the variability of the fertilizer on the soil traditionally. Soil samples taken separately and mixed like a single sample is analyzed and a single standard fertilization norm is recommended according to the data obtained from the results. However, variability in the soil can be detected with sampling depending on the grid or soil groups with precision agriculture technology. Variable quantity fertilization can be performed as a result of this (Sındır and Tekin 2002).

Excessive rise in input prices makes precision agriculture applications more important with the efforts to minimize the home economic costs in terms of today's conditions. Being economical in the use of variable quantity and sufficient data among the reduction of inputs provides large records in the protection of environmental health. In addition, it also helps to avoid dissipation. Precision farming techniques can be applied in every stage from harvesting the soil to handling. These techniques can be helpful in performing soil analysis, soil tillage, planting, fertilizing, spraying, crop monitoring and harvesting operations more efficiently.

Precision agriculture targets include; reduction of fertilizer and pharmaceutical chemicals costs, reduction of environmental pollution, provision of high quantity and quality product, provision of operation and production decisions for a more effective flow of information, creation of register order in agriculture.

Land size is of great importance for the implementation precision farming in practice. The land should be in the size that will make the variable amounts application possible.

Variability should be determined first for the variable input application and they must be made to use quantitative and practical factors that cause variability should be determined. The procedures for the solution of the problem must be chosen correctly and economic return of the application must be analyzed well. Processes and methods that will bring definite economy to the variable input application should be chosen.

The adverse effects of fertilizers and medicines to the environment and human health are known. In this study, a computer program that controls an electronic

system that is used to achieve maximum efficiency in optimum use of fertilizers in agriculture and make variable level application to avoid unnecessary use of fertilizers was developed.

Positioning system (Trimble AgGPS 132), double-disc centrifuge machines and variable-level distributed control system was used as material. Varied level control system consists of 2 pcs stepper motor, one PIC card that controls this motor and motion transmission part.

Flow sheet has been created after determining the duties of the program. Software that can create application maps using Microsoft Visual Basic (VB 6.0) programming language through the flow sheet and control the electronic system that makes varied level application was developed.

MATERIAL and METHODS

Material

The material used in this study is described below:

Trimble AgGPS 132 model GPS receiver was used in the study as positioning system..

Fertiliser Spreader



Figure 1. Centrifugal fertiliser spreader with two spinner discs

The appearance of fertilizer distribution machinery is given in Figure and technical specifications are given in Table 1. The movement from the tail shaft in double-disc machines transmits first to the right and left and are sent to the disc and mixer by rotating 90 ° C with the help of bevel gears placed for each disc.

Table 1. Technical specifications of centrifugal fertilizer spreader

| Technical specifications | Value |
|--------------------------|-------|
| Width (mm) | 2000 |
| Height (mm) | 1610 |
| Length (mm) | 1135 |
| Capacity | 1000 |
| Working width (mm) | 12-24 |
| Weight (mm) | 320 |

Variable rate fertiliser control unit

Geo-data and previously prepared fertilizer of the field requirement will be loaded on the computer. Location will be control to see whether or not there will be a change in the fertilizer norms and the valve position that controls the flowing fertilizers will be changed if deemed necessary. Diagrammatic figure of the control system is shown in Figure 2, step motor producing the necessary movement to change the location of the valve is shown in Figure 3 and the placement of the step motor on the centrifugal fertilizer distribution machine is given in Figure 4.

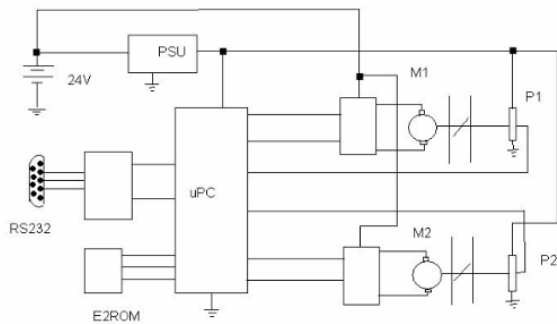


Figure 2. Schematic view of electronic control circuit



Figure 3. Stepper motor

2 pcs stepper motor fertilizer distribution machine used for the system is mounted as shown in Figure 5. The final version of the engine mount is as shown in Figure 6. Then the electricity and control board connections of these motors are made (Figure 7)

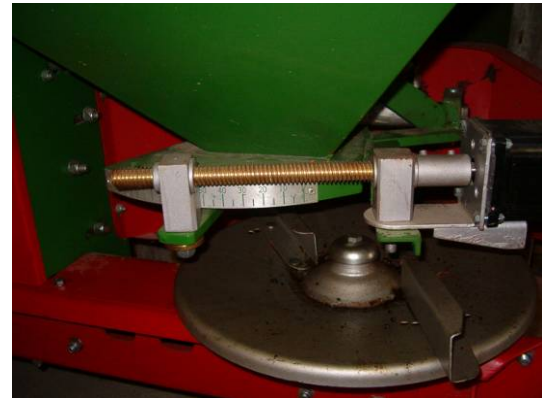


Figure 4. Distribution unit with stepper motor



Figure 5. General view of spinner discs with stepper motors



Figure 6. Stepper motor and electronic control card (PIC)

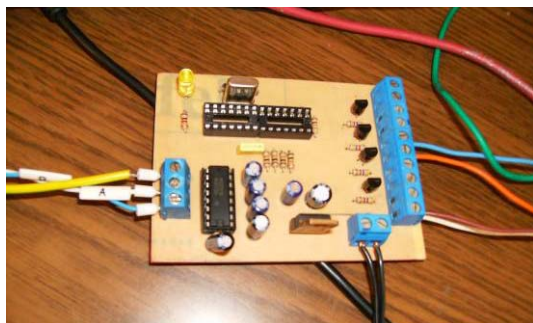


Figure 7. Electronic control card

Methods

Developing mapping software and tests

Flow diagram is used to explain the process flow logic of the mathematical models developing a computer program.

In this study, workflow diagrams that establish the above-mentioned events and programs were created.

The written program was developed using Microsoft Visual Basic 6.0 programming language and Microsoft Access database that work under the Microsoft Windows operating system and was packed using "Package & Deployment Wizard" that is a component of the same program and was converted into a running program.

The testing on whether or not the developed program works was conducted in laboratory conditions. Valve openings were controlled according to the fertilizer norms given in specified locations.

Software structure and working principles

The support of "Microsoft Access" database has been benefited from in the development of the program and software was developed with the Microsoft Visual Basic 6.0" software platform. The technical information such as farm records, field related plot details, definitive name of the machine to be used, manufacturers, business size and tail rotation speed and applicable products (fertilizers, drugs, etc.) in the program are transferred to the interface of the program from the data received from the Trimble AgGPS 132 GPS receiver and are being used.

The data that will be used in the program through the menus on the main screen are entered.

The information held in the program;

1. Farmers or farm recording
2. Field recordings

3. Parcel Records
4. Machinery Records
5. Product Registration
6. Application Map procedures

Farmer and farms log

Real Person or Legal Entity can be registered in the section where information regarding whom the Field and Parcel records belong to are kept.

Field log

We benefit from this section to record the records of registered farmer or farm once farmer or farm registration is completed. Logically, farmer or farm is based on the record.

The coordinates of the field are entered once registered and this way the coordinates of the field boundary is entered.

Parcel log

Field can be divided into parcels if requested once farmer or farm or field records are completed. If this is not wanted, then a single parcel registration is recorded by giving the same coordinates.

The register logic in the parcel records is same as the "Field Recordings" section. These entered data will later be used to create maps.

Agricultural machine log

Fertilizer distribution machines are stored in this section. The data of tail axle rotation speed and job width to be used in the application map are recorded.

Fertiliser log

It is the section where products used in fertilizing are recorded and is recorded in the same principle as "Machine Records".

Fertiliser rate

In this part of the program, fertilizer discharge tables for those given from the factory where the machine is entered are recorded. Velocity is fixed and determined as 6, 8, 10, 12, 14 km / h. The name of the machine and type of the fertilizer that will be discharged are chosen and the scale value of the machine is entered in the manual. Changing or updating the values on the table is made in a very simple manner and saves speed and time.

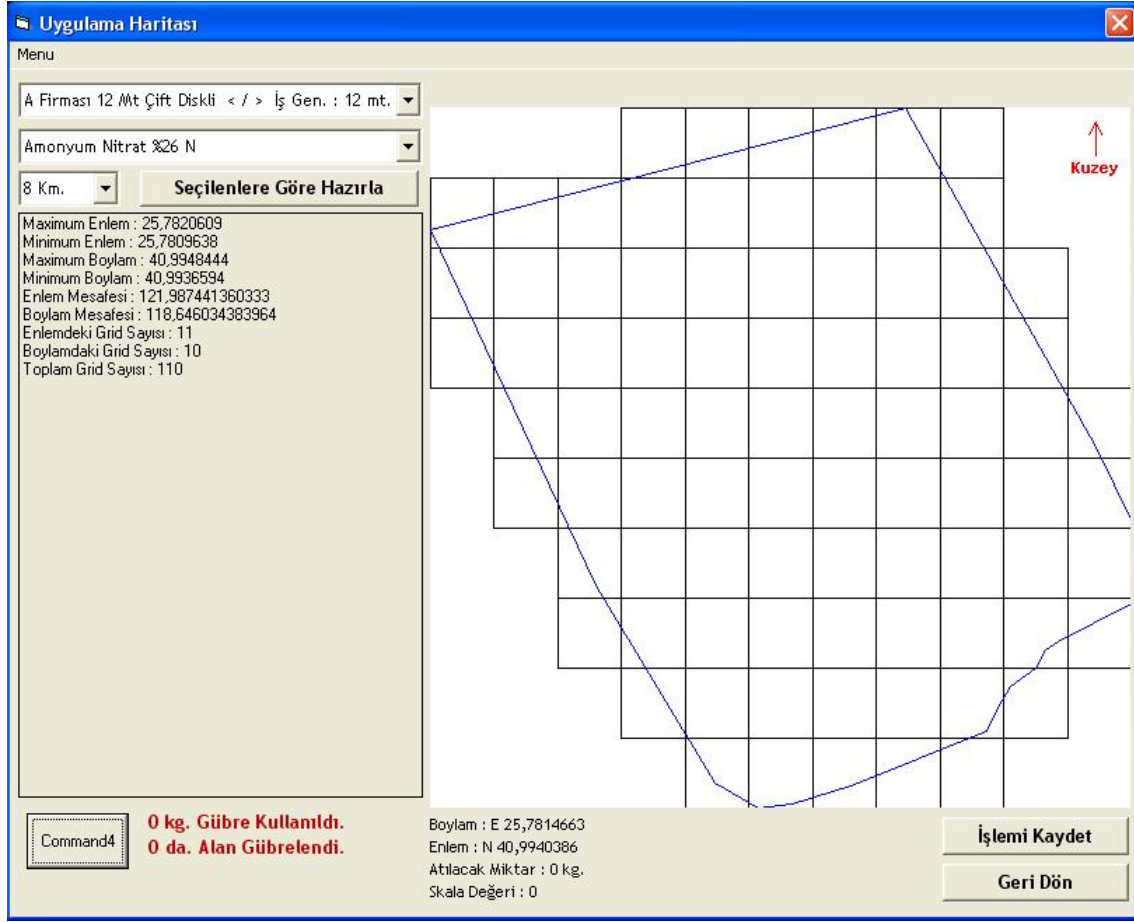


Figure 8. Overview of the application Map

Application map software

As a general principle, the program saves the above-mentioned records in its database; field or parcel where the application will take place will be chosen once all records are entered correctly and fully. Then log is created by choosing the fertilizer, fertilizer machines and fertilizing speed and thereby application map process begins with the creation of the graphics on the screen (Figure 8).

Then necessary data are placed in the parcel divided with grids with the help of the mouse. In this section cell to cell value assignment can be made as well as designating desired value to the unassigned cells. During the value assignment, previously entered data can be chosen or specific value assignments can be made.

The amount of fertilizer used according to the cell values and fertilized area is calculated transiently. Value assignment process is completed with an

explanation describing all the assignment processes is entered. Test of the program or prepared application map may take place after this process.

RESULTS

The "Application Map Test" form opens and the previously saved application map is selected. With the RS232 connection and the information in NMEA standard (\$ GPGGA: GPS Position Message) and (\$ GPGLL: GPS Latitude / longitude Messaging) from the GPS are used to send the necessary command to the step motor through the PIC card according to the position of the tractor on the field and amount of fertilizers to be thrown to the grid. This cycle will continue until the process is completed.

It has been determined that the program was successful in the laboratory testing and that it transmits desired commands appropriately and timely to the step motors.

DISCUSSION and CONCLUSION

A field was divided into grids where the field border coordinates are known to create application map programmatically and different fertilizer norms were assigned to these split grids. The field is divided into grids by accepting the width of the work of the fertilizer distribution machine used in the system as the width of the grid. It has been observed that communications with GPS provide seamlessly communication, also the established mechanisms and fertilizer distribution machinery are in compliance with the desired movement in the step motor and the tables that come with the machine in the laboratory experiment and required valve patency was provided.

REFERENCES

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Program set the fertilizer valve to a range as a result of the necessary calculations and analysis required by taking the data from requested parcel to the grid from the GPS device instantaneously.

Developed program is not only beneficial for the centrifugal fertilizer distribution machine as its development will be beneficial in all agricultural tools and machinery used in agricultural production, casting seed, fertilizer and drugs to the field. This is because, these type of programs are purchased from abroad by paying very high amount of money. This program and the part about the application map are designed and developed to be used in our country's conditions completely.

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