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VARIABLE RATE TECHNOLOGY FOR A SINGLE FERTILIZER APPLICATION

Summary

The paper describes variable rate technology for a single fertilizer application using GPS technology. The research was conducted in one of the model agricultural holdings located in the Opole Voivodeship. The analysis was based on the yield of rape in 2007 and 2008.
***Key words**: fertilization, single fertilizers, variable rate, GPS*

1. Introduction

The pace of life in modern society, technological progress, globalization and climate change cause high volatility of environment, in which companies and agricultural holdings operate. The above mentioned factors significantly affect development of human consciousness and pose new challenges for business entities. The tendency to reduce negative economic effects of human activity by increasing the interest in issues related to the impact of the economy on the environment cause searching for various management methods to enable sustainable development. Agriculture is a specific sector of its economy, heavily dependent on natural conditions. In recent years, consumer preferences were significantly changed. Consumers more and more insist on production of safe and wholesome food, which forces owners of agricultural undertakings to change the approach to current production methods. One of the methods for changing agricultural production, aimed at the welfare of the environment without losing productivity is to introduce modern techniques for fertilizer application. The conventional plant fertilization and protection system causes frequent insufficiency in dosage or vice versa over-dosage of yielding. The used cultivation methods consider, only in a small extend, local variations in habitat conditions, and fertilizer doses and protection products on plant and seed, as well as machine operating parameters are fixed according to standard (average) conditions prevailing in the field. This is followed by obtaining lower yield on fertile soils and vice versa, on poorer soils, there is unnecessary overdosage of fertilizers. The research paper describes data collected and analysed on one of agricultural holdings in the Opole Voivodeship, where variable rate application of a single fertilizer was used [4, 2].

2. Objective and Scope of the research paper

The objective of the paper is to present and analyse modern and innovative fertilizer application technique with the use of GPS system. The research was conducted on an agricultural holding in the Opole Voivodeship. Conclusions are based on the yield of rape in 2007 and 2008, taking into account fertilization doses and soil pH.

3. Variable rate application of single mineral fertilizers

In recent years, precision farming is subject to very dynamic development. The basis of precision farming is to collect information about natural variability of a particular area, such as field that are of high precision; later on the data is used to prepare and adjust precision agronomic treatments to this variability [2].

The most important part in precision farming play very accurate maps. Maps are created by applying such technologies as Global Positioning System (GPS) and Geographic Information System (GIS). Maps submit precise contours of fields and the changing abundance in soil according to macro-nutrients such as phosphorus, potassium and magnesium, as well as minerals, including zinc, manganese, copper and iron. On the maps can also be included such information as soil pH changes in a particular area. The main activity during implementation of precision farming on the holding is to create digital maps of soil richness and variability. The first step, when the GPS technology is being used, is to determine with high accuracy the field borders, using a specially adapted vehicle equipped with GPS receiver, board computer and automatic soil sampling machine [2].

Some solutions for vehicles used for soil sampling are presented in Fig. 1. The farm, being subject of the research studies, uses services of Agrocom company, where for collecting the soil samples, such vehicles as quads are used.

4. Research methodology and analysis

The research studies were performed on one of farms located within the area of Namysłów Poviat (county) in the Opole Voivodeship. Further in the research paper, the agricultural holding is referred as farm X, because the owner did not give his consent to use contact details of the holding. The research studies were conducted in 2009.

Farm X has the acreage of 1150 ha. In 2009, the cultivation was carried out according to the following: wheat 550ha, oilseed rape 400ha, potatoes 150ha and sugar beet 50ha. The farm also runs animal breeding in the amount of 80 head of dairy cows. On the analysed farm, variable rate fertilizer application was introduced. Abundance maps are established based on soil samples collected by the Agrocom company, which are analysed in OSChR in Gliwice. The analysed farm uses fertilizers of single-component or with predominance of one component. Such fertilizers must be employed, when variable rate application is used.

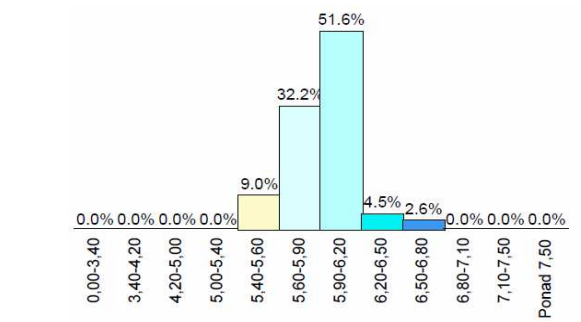
Oilseed rape field with application of variable rate fertilization was subject of this study. Yields obtained during the period of two years and fertilizer doses applied in particular years were subject to the comparative analysis.

Fig. 1. Vehicles for soil sampling [Agro Technology]

Table 1. Characteristics of fields that were subject to the research [own source]

Year	area [ha]	Soil pH	K_2O mg/100g	Mg Mg/100g	P_2O_5 Mg/100g
2007	46	5.0-6.8	15.52	5.66	29.28
2008	46	5.4-6.8	15.07	5.56	27.29

A



B

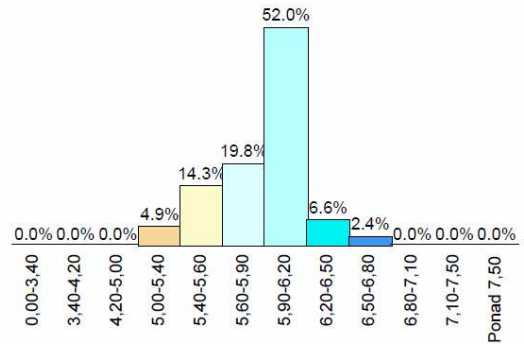
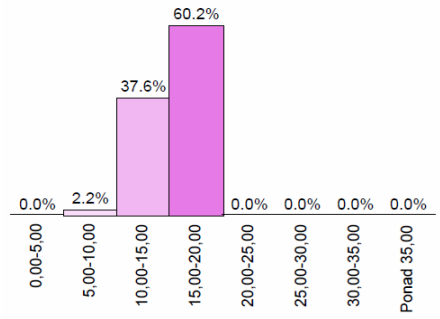


Fig. 2. Soil pH for A - 2007, B - 2008 [own source]

A



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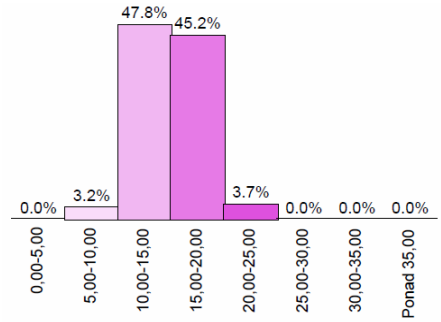
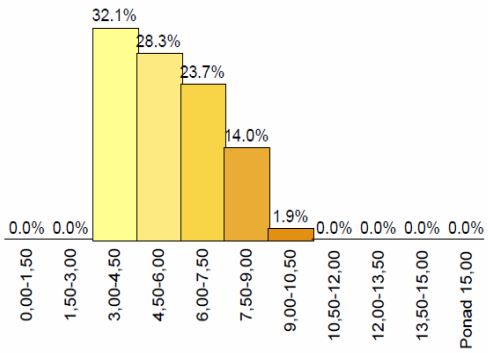


Fig. 3. Applied fertilization of K_2O [mg/100g]; A - 2008, B - 2009 [own source]

A



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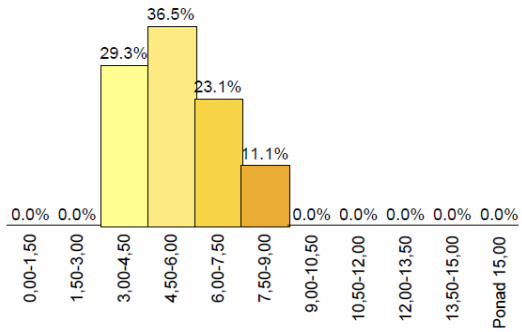
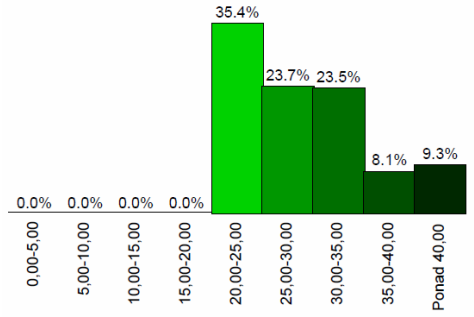


Fig. 4. Applied fertilization of Mg [mg/100g]; A - 2008, B - 2009 [own source]

The data analysis indicates that the soil pH in 2009 was increased, and the amount of applied fertilisers decreased. It can be said that soil culture has improved in a single year.

Considering the high variability of soil and varying soil richness in nutrients, which occur in fields of at least 20 hectares tends to apply fertilizers with variable dosage. This refers mainly to fields where the soil richness is average or high; while in areas where the soil richness is low, the economic effect does not directly reflect the soil application of fertilizers, but it can be later observed in the harvest.

A



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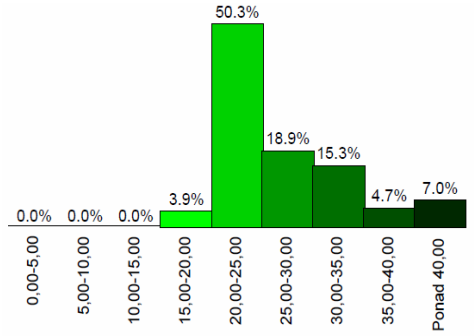

Fig. 5. Applied fertilization of P_2O_5 [mg/100g]; A - 2008, B - 2009 [own source]

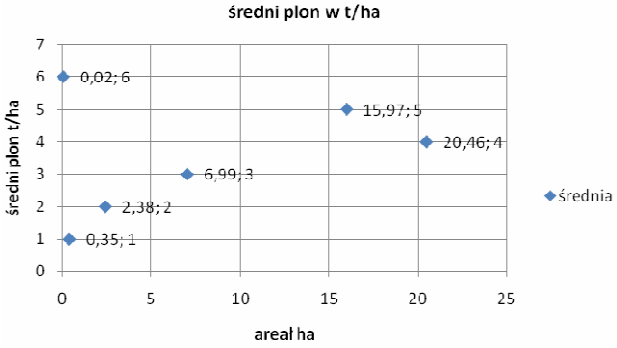

Fig. 6. Average oilseed rape yield in 2008

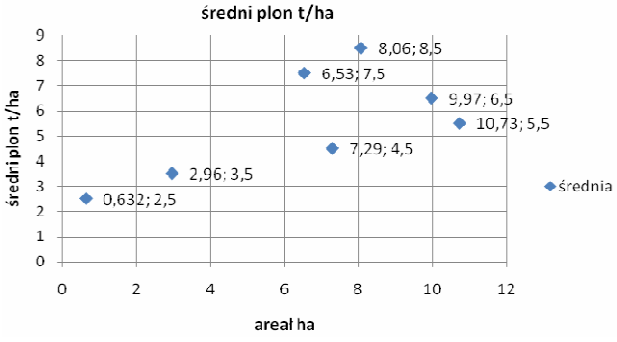

Fig. 7. Average oilseed rape yield in 2009

At the farm X, savings from all fields using variable rate seeding were at the average level of about 30%. Purchase of equipment for variable rate fertilizer application based on GPS is a significant expense for a potential investor, but at the Farm X it turned back after one year. The use of new technologies in farming, based on GPS system is justified in terms of economy. Economic conditions force increased profitability of production due to increase in prices of production means and reduction in prices of agricultural products. Improved efficiency, due to new technologies affect faster return on investments related with their implementation.

5. Conclusion

1. The use of variable rate application of single-dose fertilizers allowed for improvement of soil structure, which in turn, affected the yield size. Analysing and comparing 2008 and 2009, it shall be noted that the soil pH was changed from 5 to 5.4.

2. In 2009, the amount of applied fertilizers was significantly changed, which in turn led to reduction in oilseed rape production costs. The dosage of K_2O was reduced in 2009 by 0.45 mg/100g, Mg by 0.1 mg/100g and P_2O_5 by 1.99 mg/100g.

3. In 2008, oilseed rape corps were at the level of 3.97 t/ha and in 2009, of 6.23 t/ha.

6. References

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