EXAMINATION OF FERTILIZATION OF WINTER WHEAT ON MEADOW CHERNOZEM SOIL

P. JAKAB, D. FESTŐ, G. ZOLTÁN, L. KOMAREK

University of Szeged, Faculty of Agriculture Andrássy str. 15. Hódmezővásárhely, Hungary,
e-mail: jakabpeter@mgk.u-szeged.hu

Abstract. *We studied the effect of different fertilization dosages on the yield and some generative factors (thousand seed weight, lenght of spike, number of spiklets) of winter wheat in 2015-2016 years. The experiment carried out on the area of SZTE Tangazdaság Ltd, in three replications after alfalfa forecrop. The soil of the experiment was meadow soil. The year of 2015-2016 was favourable for winter wheat. The amount of precipitation in the vegetative period of winter wheat was higher by 92.8 mm than the average. Beside the control we applied four fertilizer treatments: N80PK30, N100PK30, N120PK0, N120PK50 kg/ha active ingredients. We processed the obtained data by single factor variant analysis. We reached the highest yield in the N80PK30 treatment, which was significantly higher compared the control. Among the examined generative factors, fertilization treatments increased significantly the length of spike and number of spiklets compared the control. Under the influence of fertilization the plant height also changed significantly.*

Key words: *winter wheat, fertilization, yield, generative factors*

INTRODUCTION

Nutrient supply is one is the most important agrotechnical element in winter wheat production. It had a direct and indirect effect on the other agrotechnical components. The proper fertilization is not only the yield and the yield stability can increased, but also can improve the quality of winter wheat (PEPÓ AND ZSOMBIK, 2002). Numerous macro-, meso- and microelements had importance in winter wheat fertilization. However, in the practice only three macronutrients (N, P, K) is of particular importance. Among of these three macroelements, the nitrogen had the highest effect on the yield and quality of winter wheat (ÁRENDÁS, 2005). The efficiency of nitrogen fertilization influences the time of application and sharing in great extent (ÁRENDÁS ET AL., 2006, KAJDI, 2005). In the case of same N dosage the shared N (winter + spring) much more effective compared to a single application (only fall or only spring) (PEPÓ, 2001). Based on the domestic and foreign results show that 300-350 kg/ha NPK is the optimum nutrient demand of winter wheat. This nutrient amount can modify the ecological, biological and agrotechnical factors. There are significant differences between fertilizer and N reaction of different winter wheat genotypes (PEPÓ, 2014; SÁRVÁRI, 2006).

The low yield averages in winter wheat production can be due to the fall-back of chemical fertilisation; this is why the use of fertilisers must be increased in order to reach higher and more consistent amounts of crop (HORVÁTH AND KOMAREK, 2016; KOMAREK 2006, 2007a, 2007b, 2008).

Nowadays more and more farmers use different soil bacterium preparations besides the fertilizers. This products contains different bacteriums which can improve the nutrient supply of plant. With the application of this products we can reduce the amount of fertilizers, which enables the environmentally friendly and economical production. They improve the physical properties of the soil, thereby improving physical and chemical properties of the soil,

and maintain the soil fertility (JAKAB ET AL., 2004, JAKAB 2010; JAKAB AND JAKABNÉ, 2013A; JAKAB AND JAKABNÉ 2013B; SÜLI-ZAKAR AND JAKAB, 2016).

Beside the yield amount the nutrient supply had great effect on the different yield components of winter wheat. The higher N dosage increased the number of spikes and the number of grains in spike (RUZSÁNYI, 1985).

In addition to the nitrogen the phosphorus also play an important role in increasing the number of spike of winter wheat (RAGASITS, 1998).

There is significant correlation between N supply and thousand seed weight. Fertilization had a significant effect on the length of spike, weight of spike and grain number of spike (JAKAB ET AL., 2016; LÖNHARDNÉ ET AL., 1995).

MATERIAL AND METHODS

The experiment was set on the area of SZTE Tangazdaság Ltd. in Hódmezővásárhely in 2015-2016 years. The soil was meadow chernozem, the reaction of which was nearly neutral (pH_{KCL} 7.17). Before setting the experiment the soil analysis data showed that it had proper nitrogen, low phosphor and very good potassium contents (Table 1).

Table 1

Main properties of the experimental field area

pH (KCL)	P_2O_5 (mg/kg)	K_2O (mg/kg)	Humus (%)	Soil plasticity value (K_A)
7.14	85	561	3.1	55

Weather in the experimental years

The year 2015-2016 was favourable for winter wheat production. The amount of precipitation in the vegetative period of winter wheat was higher by 92.8 mm than the average. The distribution of precipitation was unfavourable. In October and February fall more rain than the average, in March, April and May fall less rain compared the average (Table 2).

Table 2

The distribution of precipitation in the vegetative period of winter wheat in 2015-2016

Month	Rainfall (mm)	Average rainfall (mm)	Difference (mm)
October	88.3	34.7	53.6
November	34.3	41.1	-6.8
December	7.3	43.0	-35.7
January	48.4	30.6	17.8
February	84.2	30.1	54.1
March	21.1	29.8	-8.7
April	19.4	39.9	-20.5
May	38.8	58	-19.2
June	86.0	75.3	10.7
July	106.0	58.7	47.3
Total amount of rainfall (mm)	**533.8**	**441.0**	**92.8**

Main features of the agro-technology applied

The small-scaled plough experiment was set in three replications, organised as a random block in 2015. Beside the control we applied four fertilizer treatments: N80PK30, N100PK30, N120PK0, N120PK30 kg/ha active ingreadients. The preceding crop was alfalfa. Fall tillage involved deep ploughing at 30 cm depth. Before the harvest we calculated the yield

components (thousand seed weight, lenght of spike, number of spiklets). We processed the obtained data by single factor variant analysis (SVÁB, 1981).

RESULTS AND DISCUSSION

Fertilization had a great effect on the yield components and on the yield of winter wheat. Without any fertilizers the yield was 5.7 t/ha. It shows, that this variety has good nutrient exploration and utilization capacity. The newer winter wheat varieties are improved both in the natural nutrient exploration and utilisation capacity and in their reaction of fertilizers. In N80PK30 treatment we reached the maximum yield amount, 7.37 t/ha, which was significantly higher compared the control. The higher fertilizer doses did not increase the yield compared the N80PK30 treatment. Alfalfa was favourable forecrop, therefore the maximum yield was in the least (N80PK30) fertilizer treatment (Figure 1).

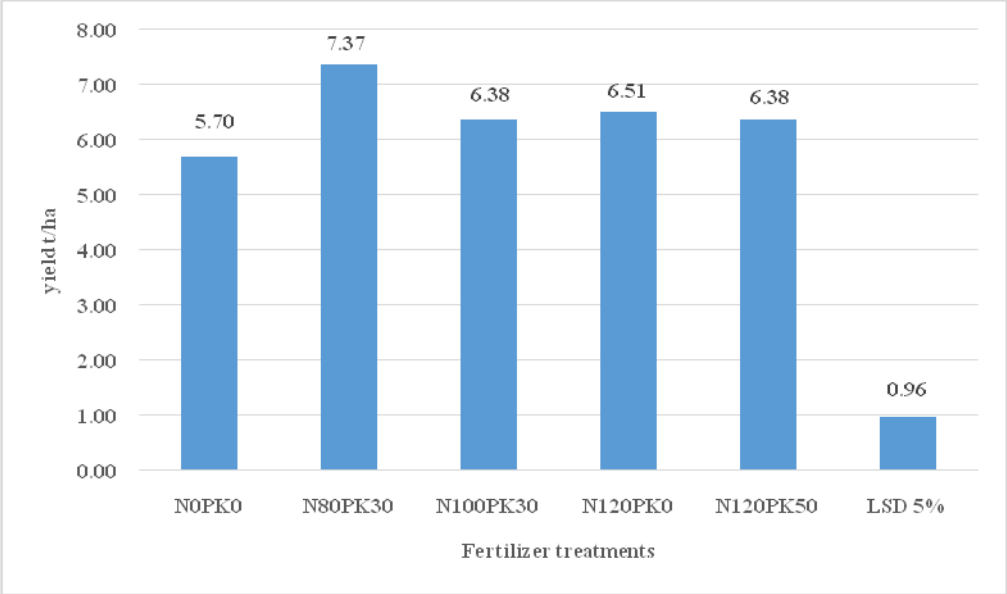

Figure 1 The yield of winter wheat in different fertilizer treatments

We studied the effect fertilization on the generative factors of winter wheat (thousand seed weight, length of spike, number of spiklets, number of fertile shoots). The thousand seed weight is highly dependent on the genetically background of variety. However, the ecological and agrotechnical factors are able to influence this value. Amoung the agrotechnical factors, the fertilization had the highest effect on this property. Our study proved, that the thousand seed weight is strongly dependent the genotype. The thousand seed weight was 43.0 g in control treatment. Under the influence of fertilization the values increased, but this effect was not significant (Figure 2).

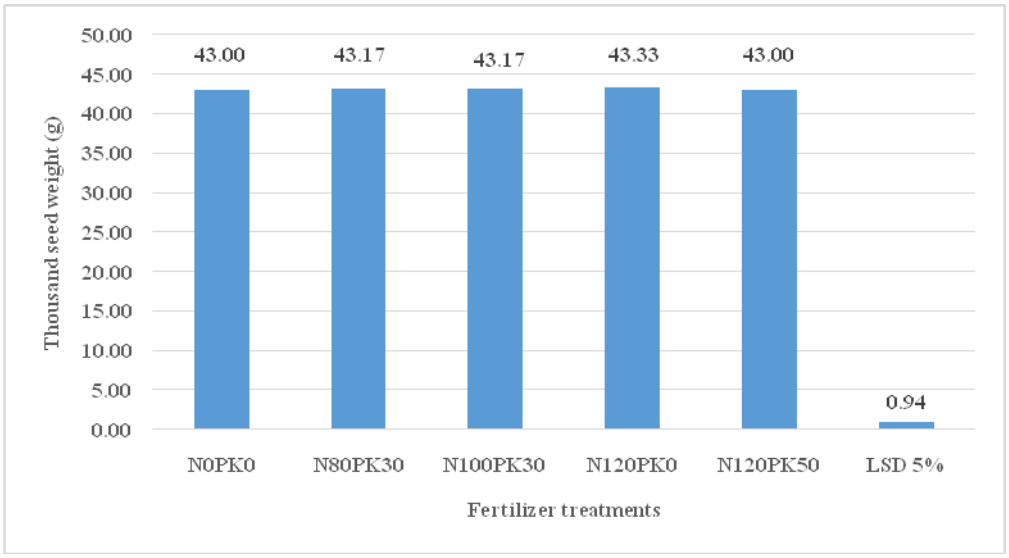

Figure 2 The effect of fertilization on the thousand seed weight of winter wheat

Like the thousand seed weight, the length of spike also strongly dependent on the genetical background of the variety. The fertilization can increased the length of spike. The larger spike results higher yields. The length of spike in control treatment was 8.32 cm. Under the influence of fertilization the values increased (8.84-9.45 cm). The highest values, 9.13 cm and 9.45 cm were significantly higher compared the control (Figure 3).

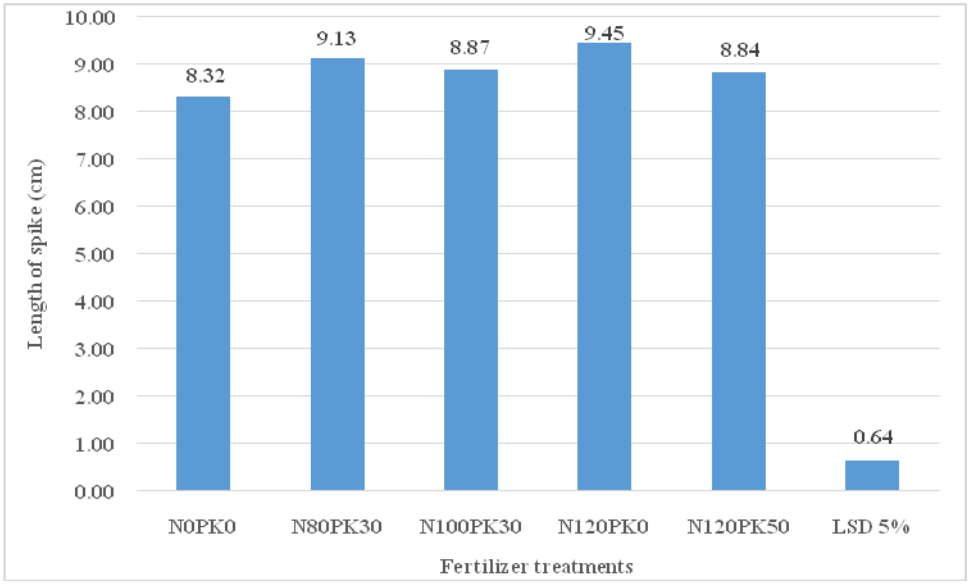

Figure 3 The effect of fertilization on the length of spike of winter wheat

The length of spike dependent the number of spiklets well. The more number of spiklets ensure the development of higher yields. In the case of number of spiklets also were significantly differences. We calculated significantly more spiklets in N80PK30, N120PK0 and N120PK50 treatments compared to control treatment (Figure 4).

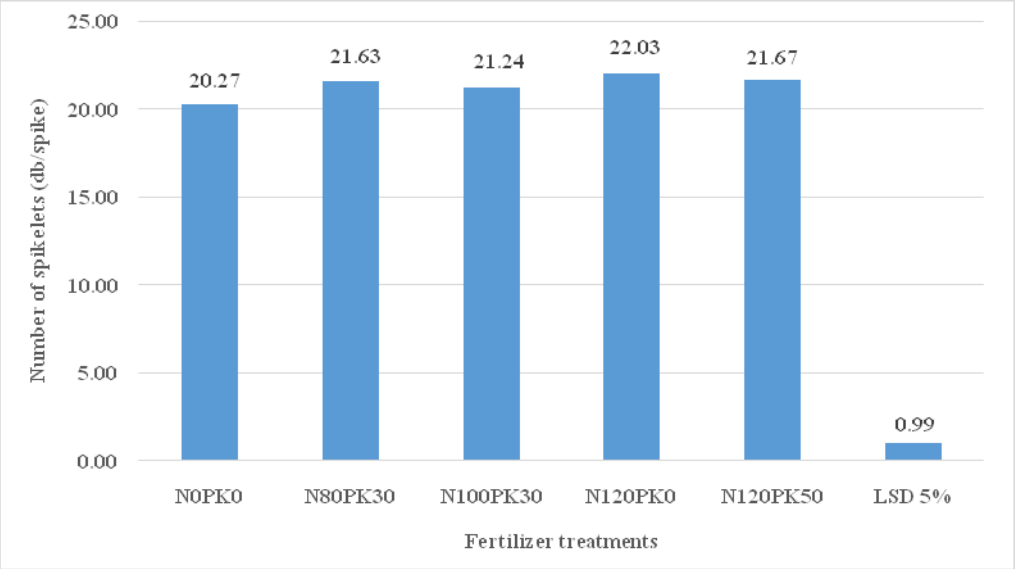

Figure 4 The effect of fertilization on the number of spikelets of winter wheat

The number of fertile shoot/0.5 m is an important yield component. We studied how changed the number of fertile shoots in different fertilizer treatments. The minimum value of fertile shoot was in control treatment (64.33 pieces/0.5 m). The number of fertile shoots was the highest in N80PK30 treatment (84.67 pieces/0.5m). The difference wasn't significant between control and this treatment. In the higher fertilizer treatments (N100PK30, N120PK0, N120PK50) we calculated less productive shoots (from 65.00 to 69.00 pieces/0.5 m), compared the N80PK30 treatment (Figure 5).

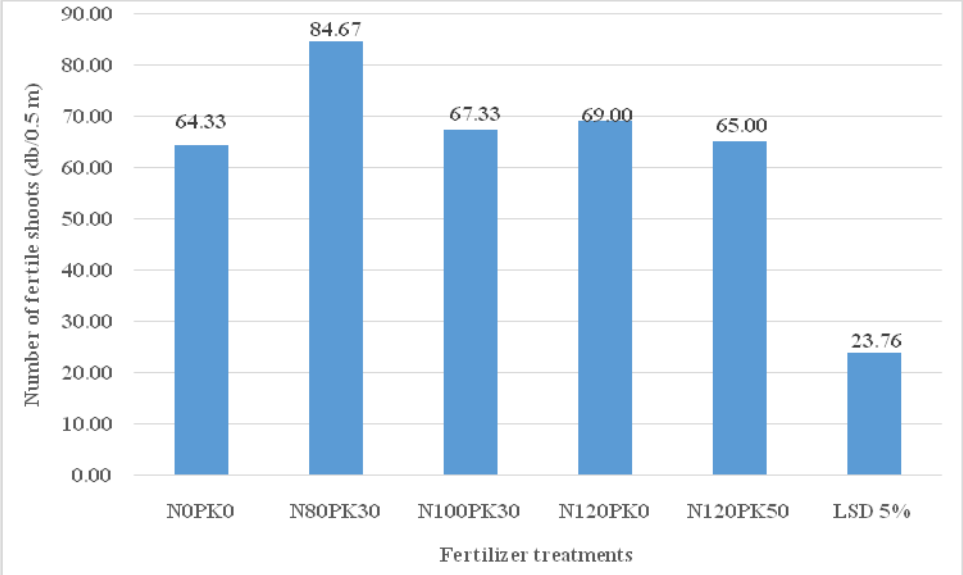

Figure 5 The effect of fertilization on the number of fertile shoot/0.5 m of winter wheat

The plant height is an important yield stability component of winter wheat. We examined the effect of fertilization on the plants height of winter wheat. The height of winter wheat was 108.73 cm is control treatment. Under the influence of fertilization we measured higher values (110.73-119.53 cm). Compared the control, in all treatments were significantly higher values, except the N100PK30 treatment (Figure 6). The increase of plant height did not cause significant lodging.

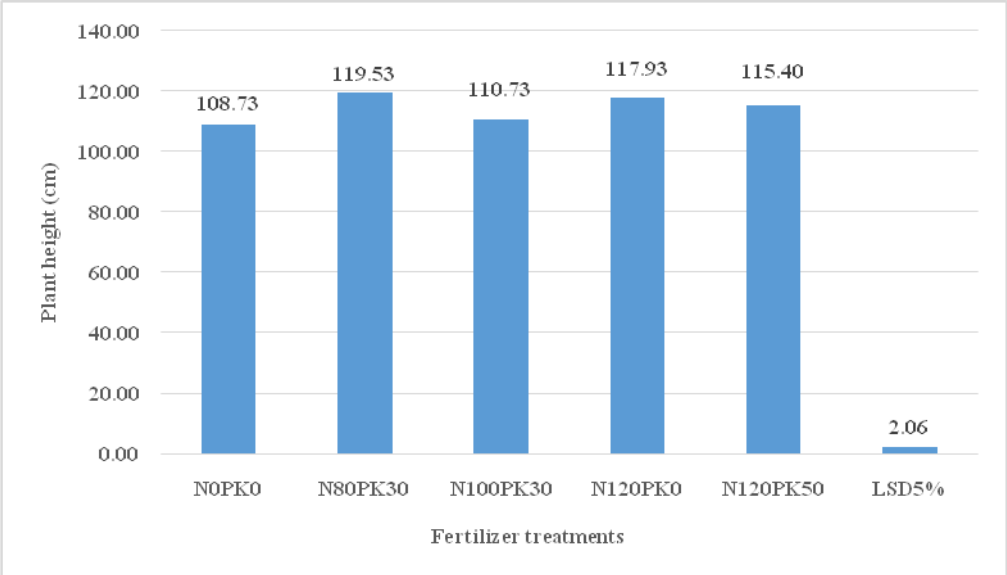

Figure 6 The effect of fertilization on the plant height (cm)

CONCLUSIONS

The year 2015-2016 was favourable for winter wheat production. Therefore the yield of control plots was relatively high, 5.7 t/ha. Compared this result we measured higher result is fertilizer treatments. Due to favourable preceding crop (alfalfa) we measured the highest yield in the lowest fertilizer treatment. The fertilization had different effect on the examined generative factors. The thousand seed weight did not change significantly, but the change of length of spike and number of spiklets under the influence of fertilization was significant.

Nowadays the application of mineral fertilization is very important economical and environmental protection issue. Therefore, it is of high importance to determine the optimum fertilizer amount of winter wheat. This is relevant in order to improve the efficiency of fertilizer application, just as to decrease environmental contamination. Our results proved, that the application of favourable preceding crop, we can reduce the amount of fertilizer.

BIBLIOGRAPHY

ÁRENDÁS T., 2005, A piacképes búza titka. Mezőgazdasági Tanácsok. XIV. 6.

ÁRENDÁS T., BERZSENYI Z., LÁNG L., BEDŐ Z., 2006, A minőségi búza termesztésének néhány agrotechnikai szempontja a martonvásári kutatási eredmények tükrében. In.: Búzavertikum aktuális kérdései (Szerk. Pepó P.). Szaktanácsadási Füzetek 2. Debrecen. 73-83.

HORVÁTH J., KOMAREK L., 2016, A világ mezőgazdaságának fejlődési tendenciái, Szegedi Tudományegyetem Mezőgazdasági Kar, Hódmezővásárhely, 270 (ISBN:978 963 306 496 2)

JAKAB P., 2010, Talajbaktérium készítmények alkalmazása a fenntartható növénytermesztésben. Összefoglaló. [In: Kóródi M. (ed.) Tudomány határok nélkül: Válságjelenségek összefüggései a gazdaságban és a társadalomban]. Szolnoki Főiskola, Szolnok, 99.

JAKAB P., FUTÓ Z., LÉVAI K., NAGY P., 2004, A tápanyagellátás hatása az őszi búza fajták termésére. Összefoglaló. [In: Kalmár I. (ed.) IV: alföldi Tudományos Tájgazdálkodási Napok] Tessedik Sámuel Főiskola Mezőgazdasági Főiskolai Kar, Mezőtúr 113.

JAKAB P., JAKABNÉ NAGY P., 2013a, Environmentally friendly nutrient supply of spring barley, Review on Agriculture and Rural Development, vol. 2. (1). 274-277.

JAKAB P., JAKABNÉ NAGY P., 2013b, Use of soil bacterium preparation in the spring barley production, Lucrari Stiintific Management Agricol, 15: (1). 35-39.

JAKAB P., FESTŐ D., KOMAREK L., 2016, A műtrágyázás hatása az őszi búza termésére és terméképző elemeire. In: Futó Zoltán (szerk.) Kihívások a mai modern mezőgazdaságban. Konferencia helye, ideje: Szarvas, Magyarország, 2016.11.24 Szarvas. Szent István Egyetemi Kiadó, 68-73. (ISBN:978-963-269-594-5)

KAJDI F., 2005, A fejtrágyázás jelentősége és gyakorlata a kalászos növények termesztésében. Mezőgazdasági Tanácsok. XIV. 13-15. p.

KOMAREK L., 2006, A rendszerváltozás utáni strukturális változások főbb jellemzői a Dél-Alföld mezőgazdaságában. In: Kertész Á, Dövényi Z, Kocsis K (szerk.). III. Magyar Földrajzi Konferencia: absztrakt kötet + CD-ROM. 238 p. Konferencia helye, ideje: Budapest, Magyarország, 2006.09.06-2006.09.07. Budapest: MTA Földrajztudományi Kutatóintézet, Paper rendszerváltozás, 10. (ISBN:963-9545-12-0)

KOMAREK L., 2007a, A Dél-Alföldi Régió súlyának, szerepének alakulása a hazai agrártermelésben. COMITATUS: ÖNKORMÁNYZATI SZEMLE 17. évf.:(9. sz.) 52-64.

KOMAREK L., 2007b, The structural changes in the agriculture of the South Great Plain since the regime change. In: Kovács Csaba (szerk.)From villages to cyberspace: In commemoration of the 65th birthday of Rezső Mészáros, Academician: Falvaktól a kibertérig: Ünnepi kötet Mészáros Rezső akadémikus 65. születésnapjára.471 p. Szeged: SZTE Természettudományi és Informatikai Kar Gazdaság- és Társadalomföldrajz Tanszék, 329-339. (ISBN:978 963 482 809 9)

KOMAREK L., 2008, A Dél-Alföld agrárszerkezetének sajátosságai.Szeged: Csongrád Megyei Agrár Információs Szolgáltató és Oktatásszervező Kht, 143. (ISBN:978-963-06-5325-1)

LÖNHARDNÉ B. É., NÉMETH I., RAGASITS I., 1995, N és P trágyázás hatása a búza generatív fejlődésére. Növénytermelés. 44.2.171-177.

PEPÓ P., 2001, A tápanyag-gazdálkodás szerepe a környezetbarát, fenntartható növénytermesztésben. XII. 7. 6-9.

PEPÓ P., ZSOMBIK L., 2002, Az őszi búza tápanyagellátásának néhány aktuális kérdése. Gyakorlati Agrofórum. XIII. 10. 2-4.

PEPÓ P., 2014, Őszi búza (Triticum aestivum L.) fajtaspecifikus tápanyagreakciója In: A fenntartható növénytermesztés fejlesztési lehetőségei. Debreceni Egyetem Mezőgazdaság-, Élelmiszertudományi és Környezetgazdálkodási Kar, Debrecen, 186-192.

RAGASITS I., 1998, A búza terméselemeinek változása a műtrágyázás hatására. Gyakorlati Agrofórum. IX. 10. 29-31.

RUZSÁNYI L., 1985, A műtrágyázás hatása az őszi búza termésére öntözött és nem öntözött kísérletben.[In: Bajai J.-Koltay Á. (szerk.): Búzatermesztési Kísérletek. 1970-1980.] Akadémiai Kiadó, Budapest, 519-527.

SÁRVÁRI M., 2006, A vetésforgó és a tápanyagellátás szerepe az őszi búza termesztésben In: Búzavertikum aktuális kérdései (szerk.: Pepó P.) Szaktanácsadási Füzetek 2. Debrecen. 64-72.

SÜLI-ZAKAR T., JAKAB P., 2016, Környezetkímélő és fenntartható gazdálkodás. Szegedi Tudományegyetem Mezőgazdasági Kar, Hódmezővásárhely. 148.

SVÁB J., 1981, Biometriai módszerek a kutatásban. Mezőgazdasági Kiadó. Budapest. 557.