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DAMEANOR OF YIELD STRUCTURE OF DARMI VARIETY UNDER TWO SOIL TYPES AND THE SAME LEVELS OF MINERAL FERTILIZATION IN PERIOD 2012-2020

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Abstract

The considered demeanor of the yield structure development of Darmi cotton variety during long researches periods grown in two types of soil. The influence of nitrogen and phosphorus fertilization on cotton under conditions on pellic vertisoil and meadow-cinnamon experiment in cotton Darmi variety during the period 2012-2020 was studied. Treatments were: N_0; N_8; N_{16}; P_0; P_8. *The numbers of 24 plot of land was design. With contents of mineral nitrogen in soil and phosphorus fertilization at rates* P_8 – P_{16} *was obtained total. During the researches period were studied development phases budding, flowering and ripening, as well as the content of nitrogen and phopshor elements in cotton Darmi variety.*

Key words: *phosphours, nitrogen, cotton, soil, yield.*

INTRODUCTION

The crucial role of mineral fertilizers in enhancing soil fertility is well known. When the amounts of fertilizers applied to the soil are reduced, it is the mineralization of organic substances, as the main component of soil fertility, that ensures the plants nutritional needs are met. Fertilizer plays a major role in influencing the plant growth and development in cotton (Kumar et al., 2020). Compared to other major nutrients, nitrogen has a major impact on yield and quality of fiber cotton (Khan et al., 2017).

Cotton has an impact on our lives beyond recognition, and genetic engineering technology has the potential to improve cotton further (Chaudhry & Guitchounts, 2003). Use of chemical fertilizers has impacted the soil by increasing salinity, diminished soil fertility, loss of water holding potential and inconsistency in soil nutrients (Savci, 2012).

Apart from fertilizing cotton nevertheless reacts to an environmental change such as temperature and rainfall in instance (Kamburova et al., 2022). In 2020 Stefantova-Dobreva, Mihova (2023), established that the highest plants were recorded in the variants fertilized with P160 and the values were 34.9% higher compared to the unfertilized control.

Nitrogen fertilizer has been shown to significantly impact physiologically active substances in cotton growth. Nitrogen influences the formation of various critical components of the cotton plant such as chlorophyll, protein, enzymes, and phytohormones (Shen, 2001). As with most cultivated species, growth and yield of cotton cultivars depend on N availability during the crop cycle.

Controlled N applications can increase crop yield and soil quality (Palomo et al., 2002; Erhart, 2005). Another key component is the cultivar choice as several breeding programs have developed high-yielding cotton varieties well adapted to different environmental conditions (Bange & Milroy, 2004; Stiller, 2005). To achieve maximum productive potential, in addition to choosing a variety for a particular region, a high level of agricultural technology is also of particular importance, one of the main elements of which is nitrogen fertilization (Biberdzic et al., 2012; Mühleisen et al., 2014).

Mean average temperature and precipitation are prime determinants of large-scale variability in plant production or annual net primary production, followed by nitrogen (N) and P (Cleveland et al. 2011).

Phosphorus (P) is an essential, non-replaceable nutrient in biology, with finite global reserves. Whereas soils may contain pools of P that could be several thousand times higher than required for plant growth, only a small soluble fraction is available for plant uptake (Sohrt et al., 2017).
According to Bindraban et al. (2020) innovative P fertilizer products and fertilization strategies must, and can be developed to markedly reduce these unintended negative environmental and health effects of excessive P. The fact that the physiological P requirement is generally lower than the amount of P taken up by plants provides an opportunity to design and apply fertilization strategies to reduce total P supply and uptake, without penalty on the yield and nutritional value of the produce.
The production of cotton, its structural and qualitative aspects of the production are essentially influenced by the conditions of the elements of the year, the elements of fertilization and the variety (Panayotova, 2002; Sawan, 2008).

MATERIALS AND METHODS

The study of the cotton variety Darmi was conducted from 2012 to 2020 on two types of soils Haplic Vertisols and Luvisols. A field trial with cotton Darmi has been set up in 2008. The plants have a conical shape. The stem is green, with a weak anthocyanin coloration when maturing. The reproductive branches are of medium length and are located high on the plant. The leaves are palmate, green, with a raised perimeter. The seeds are medium-sized, covered with gray fuzz. The fiber is white, medium-fine, with very good uniformity and maturity, measuring 31-32 mm in length, and has good strength. The yield is 39.5%. The growing period of the variety is 116-122 days. On average, for a six-year period, the September yield is 1.45 t ha^{-1}, and the total yield is 2.00 t ha^{-1}. Based on the experimental data, regression equations were derived and theoretical curves were constructed expressing dependencies between the indicators - Statistical programs ANOVA and SPSS- 10 is used.
Haplic Vertisol in the experimental field of Chirpan is suitable for growing the main agricultural crops and has the potential to form high yields. The soil is characterized by a clay mechanical composition, high moisture retention, low permeability and a stable structure that ensures the exchange of air and water within the soil. It swells significantly when moistened and reduces in volume when dried.
A characteristic feature is the presence of a thick humus horizon (70-100 cm) and a strongly compacted zone in the profile (cemented horizon), *Haplic Vertisol* belong to the group of medium-humus and most fertile soils in Southern Bulgaria. The total nitrogen reserve in 0-30 is 0.5-0.6 t ha^{-1}. The total average nitrogen reserve in the form of NH_4-N in 0-30 cm is 3.20-3.60 t ha^{-1}, while in the form of NO_3-N it is 2.80-3.20 t ha^{-1}.
The amount of total phosphorus is 100 - 250 mg/100 g of soil, but a large part of the phosphorus is bound in the form of primary phosphorus minerals, which are difficult to dissolve and poorly accessible to plants. The amount of mobile phosphorus is low. The soil of the experimental field in the city of Stara Zagora is meadow-cinnamon soil with a humus horizon (0-45 cm). The mechanical composition of the soil is medium sandy-clay. The bulk density for the surface layer is 1.07 g/cm^3 and reaches 1.34 g/cm^3 in layers 60-80 cm.
In the topsoil layer of 0-30 cm, mineral nitrogen is 75.32 to 80.12 mg/1000 g of soil, which corresponds to a good supply of nitrogen to the soil. In terms of mobile phosphorus, the soil has a low to medium supply. In the layer of 0-30 cm, its content is 4.01-5.12 mg/100 g of soil and decreases insignificantly in the lower soil layer. The soil values characterize the soil as good for the growth and development of cotton variety Darmi.

RESULTS AND DISCUSSIONS

The results obtained from the present study for the period 2012-2014 show that mineral fertilization has a very good effect on the yield of unbleached cotton. The average realized yield of unginned cotton is 1.62 t ha^{-1}. Without fertilization, the average yield of unbleached cotton is 1.32 t ha^{-1} during the study period (Table 1). The lack of nutrients inhibits the development of cotton plants, reduces both the total yield of cotton and the yield of fiber.

Table 1. Impact of mineral fertilization on the yield of unbleached cotton, average for 2012-2014, t ha^{-1}

Fertilization	Year			Average %	
	2012	2013	2014	t ha^{-1}	%
N_0P_0	1.13	1.10	1.74	1.32	100.0
N_8	1.36	1.20	2.47	1.67	126.5
N_{16}	1.42	1.44	2.32	1.73	131.1
P_8	1.20	1.17	1.71	1.36	103.0

The yield of unbleached cotton in 2014 averaged 2.47 t ha^{-1} single fertilization with N_8, significantly higher than that obtained in 2012 and 2013 - 1.36-1.20 t/ha^{-1} .

The nitrogen content during the individual phases of cotton development is proven to be influenced by the level of nitrogen fertilization, while phosphorus fertilization has a negligible effect. In the budding phase, the nitrogen content in the unfertilized variant is on average 2.0%, ranging from 2.14% in 2012 to 1.84% in 2013 (Table 2). With increasing nitrogen fertilization levels, the concentration during this phase reaches 2.97% at N_{16}. With combined NP fertilization, the changes depend on the nitrogen level. Phosphorus fertilization alone at the tested rates leads to a nitrogen concentration close to the values of the unfertilized control. The highest value - 3.40% was recorded at N_{16} in 2012.

Table 2. Nitrogen and phosphorus content of the variety Darmi by development phases, %

Fertilization	Cotton budding phase				Flowering				Cotton ripening			
	2012	2013	2014	Avarage %	2012	2013	2014	Avarage %	2012	2013	2014	Avarage %
N_0P_0	2.14	1.84	2.04	2.00	2.52	2.11	2.45	2.36	1.65	1.52	1.44	1.54
N_8	2.26	2.44	2.21	2.30	2.73	2.48	2.64	2.62	2.33	1.82	2.17	2.11
N_{16}	3.15	2.72	3.05	2.97	3.40	2.58	3.09	3.02	2.65	2.19	2.52	2.45
P_8	1.89	1.60	2.02	1.83	2.77	1.89	2.41	2.36	1.68	1.62	1.56	1.62
N_8P_8	2.36	2.56	240	2.44	2.98	2.35	2.87	2.73	2.36	1.91	2.24	2.17

With separate fertilization with N_8 and N_{16}, the total average dry matter in the maturation phase is higher than in the unfertilized phase by 23.8% and 62.7%, respectively (Table 3). Separate phosphorus fertilization contributes to an increase in dry matter by 7.6% at P_8.

Combined nitrogen-phosphorus fertilization has a proven effect on dry matter yield. When fertilizing with N_8P_8, the total dry biomass increases, averaging 519.67 t /ha^{-1} for the period, 27.8% above unfertilized. With increasing rates of combined fertilization, the dry mass of cotton also increases.

The elevated yields observed in 2018 were primarily attributed to the favorable alignment of thermal and precipitation conditions throughout the vegetative period. Cumulative rainfall of 259.7 mm during May, June, and July created optimal conditions for timely germination, uniform crop establishment, and effectively promoted the formation, retention, and development of a high number of fruiting bolls (Table 4). In contrast, the reduced yields in 2020 were mainly a consequence of elevated temperatures during the vegetation phase, combined with a prolonged summer drought. These adverse conditions resulted in significant abscission of floral buds and blossoms, and impeded the adequate filling and maturation of bolls.

Under the influence of sole nitrogen fertilization, the average total cotton yield reached its maximum value at a nitrogen application rate of 2.16 t ha^{-1} for 2018 the cultivar Darmi. The applied nitrogen rate of N_{16} had a very positive effect on the crop productivity.

Table 3. Effect of nitrogen-phosphorus fertilization on the total dry biomass of cotton in the ripening phase, t/ha^{-1}, average for 2012-2014

Fertilization	2012	2013	2014	Avarage	
				t /ha^{-1}	%
N_0P_0	380	365	475	406.67	100.00
N_8	474	450	585	504.33*	124.0
N_{16}	576	620	790	662.00***	162.8
P_8	420	396	495	437.67	107.6
N_8P_8	506	458	595	519.67**	127.79
Avarage	**471.2**	**457.8**	**588**	**506.07**	**-**
*; **; *** - proven by probability P ≤ 0,05; P ≤ 0,01; P ≤ 0,001, accordingly					

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Table 4. Impact of mineral fertilization on the yield of unbleached cotton, t/ha^{-1}, average for 2018-2020

Fertilization	Year			Average %	
	2018	2019	2020	t/ha^{-1}	%
N_0	1.76	1.52	7.93	1.36	100
N_8	2.06	1.64	8.10	1.53	112.5
N_{16}	2.11	1.68	1.05	1.61	118.4

CONCLUSIONS

The Darmi cotton variety is suitable for cultivation on both *Haplic Vertisol* and *Luvisols* soil under the specified fertilization conditions. The application of N_{16} and P_8 fertilizer rates results in higher and more stable yields, highlighting their effectiveness in supporting crop productivity. Statistical data and processing prove that nitrogen fertilization rates N_{16} significantly prove higher yield results. The study confirms that nitrogen and phosphorus fertilization levels play a crucial role in enhancing cotton yield, with balanced nutrient supply ensuring optimal plant development and fiber quality.

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