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OPTIMIZATION OF THE PRODUCTION OF BEANS COWPEA UNDER THE IMPACT OF TECHNOLOGICAL FACTORS

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Abstract

In the guidelines for increasing protein content in food population and animal at national and international level, the basic concern is the exploitation of soils in arid and semiarid climates by adapted crops ecopedological specific conditions that contribute to reduced negative climate change and sustainable agriculture. In this research at Research - Development Center for Field Crops on Sandy Soils Dabuleni during 2004-2011 aimed to reduce the negative effect of drought in the area psamosoils by the potential biological cowpea a specific plant arid climate. The results obtained show that the cultivation of cowpea *Ofelia and providing sown an area of plant nutrition 20 germinable seeds/m^2 can successfully capitalize on sandy soils of low natural heritage. Rational fertilization by $N_{60}P_{60}K_{60}$ and applying fractionated nitrogen (1/3 sowing + 2/3 vegetation) resulted in the best production results (2752 kg/ha), due to optimization of plant physiological processes. In this experiment there was a maximum of the photosynthesis process, the CO_2 28.34 micromoles/m^2/second and minimum consumption of water through perspiration, the 2.26 millimoles H_2O/m^2/second.*

Keywords: *sandy soil, cowpea, nutrition, physiology.*

INTRODUCTION

Capitalization with good results psamosoils from Oltenia Southern by the cultivation cowpea (*Vigna unguiculata* L. Walp) can not be provided without conducting thorough studies favorable climatic conditions generated by the plant are found in this area.
Research by the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria by O. Boukar and al. [3] highlights the importance cowpea cultivation in drought affected areas, primarily for human consumption due to the significant content of grains protein, carbohydrates and some minerals that are beneficial to consumer health.
Role cowpea cultivated in a sustainable agricultural system, through its use in animal nutrition and contributes to maintaining the soil fertility through manure use was highlighted in 2010 by the research of H.A.
Ajeigbe and B.B. Singh at the International Institute of Tropical Agriculture (IITA), Kano, Nigeria [1]. Being a plant with low requirements to the natural fertility of soil, cowpea are grown usually on the poorest sands, with a hummus content below 0.5%, developing through plant biology mass vegetative rich, that incorporated into soil as green manure, contribute to improved physical and chemical properties of sand, with white lupine, pea and soybean [4]. Results obtained by Marinica Gh. during 1986-1993 show that cowpea have a water consumption of 4156 m^3/ha, compared consumed soy 7153 m^3/ha [6].
Efficient valorification of sandy soils by studying plant-soil-climate relationship in the context of conservation and environmental protection is consistent with national strategy to reduce the effects of drought and combating land degradation and desertification, prepared by MARD (Ministry of Agriculture and Rural Development) Romania. In this context, choosing the range of plant genotype and study the application of nutrients is a necessity to obtain high yields, secure and stable.

MATERIAL AND METHOD

Experimentation was conducted during 2004-2011 at the Research - Development Center for Field Crops on Sandy Soils Dabuleni, under irrigation on a sandy soil with low nitrogen content (0.03 to 0.1%), well stocked phosphorus (75-105 ppm), low to medium supplied in potassium (55-95 ppm), with a low organic carbon (0.11- 0.46%) and a weak acid to neutral pH (5.3 and 6.81).

Research aimed at studying the following factors: genotype, space nutrition, fertilization.

Research has been conducted in phases (genotypes were studied during 2004-2011, space nutrition in 2004-2006, fertility was studied in two phases from 2004 to 2006 and 2011).

To meet the objective of optimizing the production results obtained, there were correlated productivity and physiology of the plant with technological factors studied and existing climatic conditions.

Physiology tests were made with apparatus LCpro + Portable Photosynthesis System. The results were interpreted statistically by using analysis of variance and mathematical functions [2]

RESULTS AND DISCUSSIONS

Analysis of climatic factors playing a role in plant growth and development, such as temperature and precipitations (Fig. 1), revealed patchy the character of their distribution and intensity, both taken during the study and multiannual average.

The data obtained from the meteorological station Research - Development Center for Field Crops on Sandy Soils Dabuleni found an increase in average air temperature of 1.34°C during 2004-2011, compared to multiannual period 1956-2011.

Although the amount of precipitation recorded during the same period is higher than the multiannual average, however their uneven distribution associated with high temperatures in air emphasizes the character of drought and obliges us to find technological solutions to the cowpea, for use in optimal conditions.

First choice of biological material is one of the measures that do not incur a cost. Of the three cowpea genotypes studied to obtain the highest yield (2587 kg/ha) the variety Ofelia, who saw a difference in production of 326 kg/ha, significantly distinct compared with Aura variety (Table 1). Space nutritional size influences the growth and development processes of cowpea plant, with implications for the level of production obtained (Fig. 2).

Sowing compared to 10 germinable seeds/m^2 when there were 1814 kg/ha grain yield increases in the 151-483 kg/ha by increasing plant density. Compared to the variant that were sown 10 germinable seeds/m^2 have been very significant differences of production of 483 kg/ha by sowing of 25 germinable seeds/m^2. Exceeding this density decreases grain production to cowpea.

Mathematical analysis of the functional link between the number of germinable seeds and grain production obtained from cowpea show a degree of determination of production under the influence of this factor of 98%.

Calculation the economic optimum shows that by seeding of 20.6 germinable seeds/m^2 to optimize grain production in cowpea.

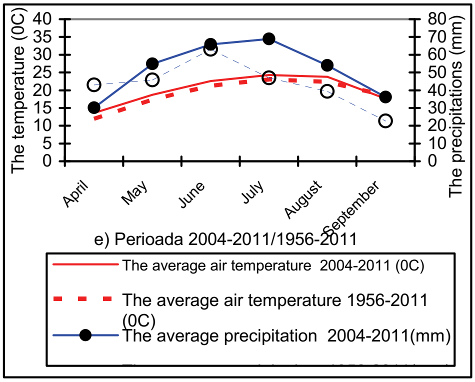

Fig. 1. Air temperature and precipitation recorded at weather station has CCDCPN Dabuleni

Table 1. Significance yields obtained in some genotypes of cowpea (2004-2011)

Genotype	Yield		Difference	Significance
	kg/ha	%	kg/ha	
Aura	2363	100	Control	Control
Ofelia	2689	105	326	**
D2-b/93	2439	99	76	-

LSD 5% = 146 kg/ha
LSD 1% = 247 kg/ha
LSD 0.1% = 479 kg/ha

Photo 1. Ofelia cowpea variety

Cowpea is a leguminous plant which he synthesizes the symbiotic way around 80.6% of nitrogen in the nutrition [4], still needs this macroelement to start installing vegetation to soil microbial activity.

Phosphorus and potassium also have a favorable influence on the formation of productivity elements on cowpea and plant resistance to stress factors on sandy soils.

The results in this (Fig. 3), shows the importance of the three macronutrients in maximizing production.

The results obtained in 2004-2006 showed a maximum of 2116 kg/ha of cowpea culture by fertilization with 30 kg nitrogen + 40 kg P_2O_5 + 40 kg K_2O / ha, resulting from fertilization a very significant difference in production, 771 kg/ha (0.1% LSD = 586 kg/ha).

Based on these results in 2011 it was initiated research that focused on higher doses of nitrogen, phosphorus and potassium and nitrogen application times in cowpea, in order to optimize production results. On sandy soils poor in organic matter, nitrogen fertilizer use is limited to losses that occur through leaching [5].

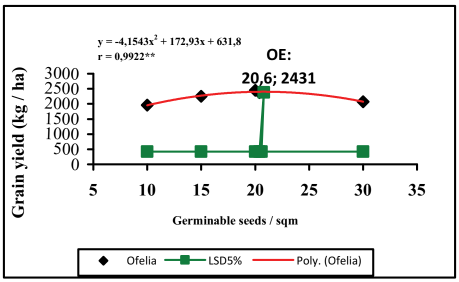

Fig. 2. Correlation between cowpea grain yield and the space of plant nutrition

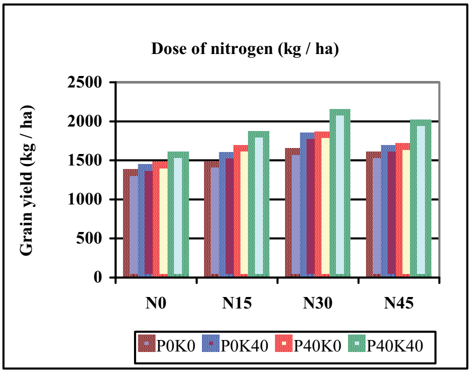

Fig. 3. Evolution cowpea grain yield depending on the dose of NPK, 2004-2006

Fractionated dose of nitrogen application reduces the losses. Measurements of plant physiology show that with increase in photosynthetic active radiation were recorded increases of CO_2 assimilation in the leaf (Table 2). There is also a differentiation of plant photosynthesis, depending on the dose of fertilization and application of nitrogen fertilizers. The cowpea crop fertilization with fractioned application of nitrogen $N_{60}P_{60}K_{60}$ and (1/3 sowing + 2/3 vegetation), photosynthesis process showed a maximum at 12 hour (28.34 µmol CO_2 $m^{-2}s^{-1}$) the surface temperature leaf was 35.6°C. to build the amounts of CO_2 plant cowpea lost 2.26 mmol H_2O $m^{-2}s^{-1}$. Greater heat stress by increasing the temperature of the leaf surface reduces the intensity of the photosynthesis process, such that at 15 hour it recorded a decline from 12 hour the same variant of fertilization, photosynthesis recorded 18.49 µmol CO_2 $m^{-2}s^{-1}$ at 15 hour, and consumption of water by sweating 5.78 mmol H_2O $m^{-2}s^{-1}$.

High nitrogen doses administered under thermal stress inhibits photosynthesis process in plants and also increases water loss through perspiration. Analyzing the correlation between fertilization and production of cowpea increases the production with favorable allocation of nutritional resources ($N_{60}P_{60}K_{60}$). It highlights a significant correlation between production and fertilization (Fig. 4).

Table 2. Influence of fertilization on the plant physiology cowpea

Experimental variant			*Cowpea plant physiology, at 12 hour		
No. var.	NPK	Time of application of nitrogen	Photosynthetic active radiation (µmol $m^{-2}s^{-1}$)	Photosynthesis (µmol CO_2 $m^{-2}s^{-1}$)	Perspiration (mmol H_2O $m^{-2}s^{-1}$)
1	$N_0P_0K_0$		1645	14.37	3.04
2	$N_0P_{60}K_0$		1753	15.34	3.65
3	$N_0P_0K_{60}$		2022	17.73	3.26
4	$N_0P_{60}K_{60}$		1875	20.29	3.56
5	$N_{30}P_{60}K_{60}$	*sowing*	1931	21.43	3.59
6		*1/3 sowing + 2/3 vegetation*	1805	20.00	2.34
7		*vegetation*	1916	23.15	3.98
8	$N_{60}P_{60}K_{60}$	*sowing*	1462	25.25	3.99
9		*1/3 sowing + 2/3 vegetation*	1712	28.34	2.26
10		*vegetation*	1606	27.23	3.39
11	$N_{90}P_{60}K_{60}$	*sowing*	1194	25.53	4.91
12		*1/3 sowing + 2/3 vegetation*	1790	26.01	3.66
13		*vegetation*	1410	26.51	3.49

*Leaf surface temperature: 34.1°C-36.2°C
*Atmospheric pressure: 1014-1016 atm.

Photo. 2. Aura cowpea variety

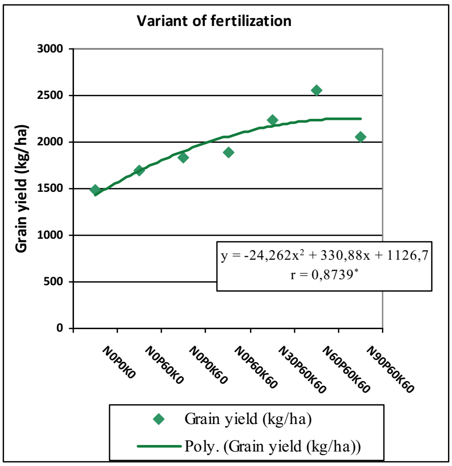

Fig. 4. The correlation between NPK fertilization and grain yield from cowpea grown on sandy soils, 2011

Results obtained from cowpea under the influence of fertilization highlights the application of higher doses of nitrogen causes the plant's vegetative growth to the detriment fructification, rich vegetation of the plant preventing sunlight penetration to the bottom of vexil flower, essential condition in the fecundation of flowers and maturation uniform clusters.

Fertilization application to determine cowpea significant to very significantly production increases from unfertilized control. The maximum production was achieved when the three macronutrients were applied in doses of N_{60} $P_{60}K_{60}$ (Table 3).

Table 3. Influence of NPK fertilization on production results in cowpea, 2011

Experimental variant		Yield		Difference	
NPK	Time of application of nitrogen	kg/ha	%	Kg/ha	Significance
$N_0P_0K_0$	-	1491	100	Mt.	Mt.
$N_0P_{60}K_0$		1690	116	229	-
$N_0P_0K_{60}$		1833	125	372	*
$N_0P_{60}K_{60}$		1894	130	433	*
$N_{30}P_{60}K_{60}$	*sowing*	2173	149	712	***
	1/3 sowing + 2/3 vegetation	2392	164	931	***
	vegetation	2143	147	682	***
$N_{60}P_{60}K_{60}$	*sowing*	2517	172	1056	***
	1/3 sowing + 2/3 vegetation	2752	188	1291	***
	vegetation	2390	164	929	***
$N_{90}P_{60}K_{60}$	*sowing*	2171	149	710	***
	1/3 sowing + 2/3 vegetation	2072	142	611	***
	vegetation	1932	132	471	**

LSD 5% - 323 kg/ha
LSD 1% - 434 kg/ha
LSD 0,1% - 572 kg/h

The application of N_{60} fractionated dose (1/3 sowing + 2/3 vegetation), an agrofond of $P_{60}K_{60}$ we obtained the best results in cowpea production (2752 kg/ha).

There is a distinct significant correlation between the 13 variants of fertilization and the production obtained from cowpea (Fig. 5).

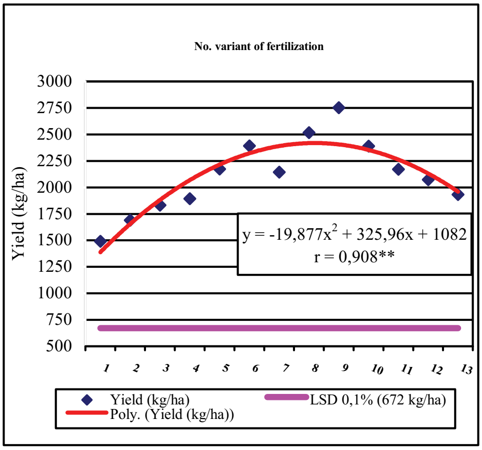

Fig. 5. The correlation between different formulas NPK fertilization and grain yield from cowpea grown on sandy soils, 2011

CONCLUSIONS

Variety of cowpea Ofelia has registered a production of 2587 kg/ha exceeds of cowpea Aura variety with a production difference of 326 kg/ha, significantly distinct. Size of area of nutrition influence the growth and development processes of plant, with implications for the level of production obtained.

Economically optimal production by 2431 kg/ha was achieved by 20.6 germinable seeds $/m^2$.

The cowpea crop fertilization with fractionated application of nitrogen $N_{60}P_{60}K_{60}$ and (1/3 sowing + 2/3 vegetation), photosynthesis process showed a maximum at 12 hour by 28.34 µmol $m^{-2}s^{-1}$ with a loss of transpiration of water by 2.26 mmol H_2O $m^{-2}s^{-1}$.

Application of fractional doses of N_{60} (1/3 sowing + 2/3 vegetation) a leading $P_{60}K_{60}$ agrofond, maximize grain production to cowpea (2752 kg/ha).

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