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INFLUENCE OF FERTILIZATION WITH POTASSIC FERTILIZERS ON CARROT CROP

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Abstract

This research deads with the behavior of various root chemical fertiliser types, especially potassic ones, applied to carrot grown on two types of soils, taking into account the yield quality and quantity, fertiliser residues in soil, nitrate pollution risk, as well as the impact on environment.

INTRODUCTION

Research was carried out in glasshouse. The two soils fertilized with several simple or combined fertiliser types (superphosphate, urea, potash salt, potassium sulfate) were quantitatively and qualitatively analyzed both before crop planting and after crop harvesting. The two soil types used for the experiment were: Alluvial soil (Ciorogârla) and Cambic chernozem (Ştefăneşti).

MATERIAL AND METHODS

The experiment was made by applying the pot-culture method with pots of 30 l capacity and 17 treatments x 4 replicates for each soil type. In this view a bifactorial experiment was organized such as:
A factor: soil type with two graduations: a_1 - Chernozem and a_2 - Alluvial soil.
B factor: fertilization system with 17 graduations.

No. of treatments	Treatments
b1	*Control*
b2	$N_{100}+KCl_{100}$
b3	$N_{100}+K_2SO_{4100}$
b4	$N_{100}+KCl_{150}$
b5	$N_{100}+K_2SO_{4150}$
b6	$P_{100}+KCl_{100}$
b7	$P_{100}+K_2SO_{4100}$
b8	$P_{100}+KCl_{150}$

b9	$P_{100}+K_2SO_{4150}$
b10	$N_{100}+ P_{100}+KCl_{100}$
b11	$N_{100}+ P_{100}+K_2SO_{4100}$
b12	$N_{100}+ P_{100}+KCl_{150}$
b13	$N_{100}+ P_{100}+K_2SO_{4150}$
b14	KCl_{100}
b15	K_2SO_{4100}
b16	KCl_{150}
b17	K_2SO_{4150}

RESULTS AND DISCUSSION

The analysis of production results led to the conclusion that the highest yields have been obtained in the case of Cambic chernozem, in contrast to the Alluvial soil where the yields were clearly lower, even if the applied technology was the same (Figure 1).

Fig. 1. CZ - chernozem and AS - aluviosoil

In both cases, the nitrogen V2; V3; V4 and V5 treatments, as well as, V10; V11; V12 and V13, i.e., where the highest rates were applied, the yields were the highest (Tables 1 and 2).

The analysis of data in table 1 regarding the yields with the carrot crop grown on **Chernozem** shows that the yields varied between 101 g/pot in the case of the control and 237 g/pot in the case of the $N_{100}+P_{100}+K_2SO_{4100}$ treatment, and, from the statistical viewpoint, as compared to the control:

- V2, V10 and V11 treatments obtained very significant yield increases;
- V3, V4, V5, V12 and V13 treatments obtained distinctly significant yield increases;
- V9 and V14 treatments obtained significant yield increases; and
- V6, V7, V8, V15, V16 and V17 treatments recorded no yield modifications.

Table 1

Interpretation - Chernozem

Treatments	Treatments	Mean, (g/pot)	Dif., (g/pot)	Significance
V1	Control	101	mt	-
V2	N_{100}+KCl_{100}	208	107	***
V3	N_{100}+KSO_{4100}	201	100	**
V4	N_{100}+KCl_{150}	192	91	**
V5	N_{100}+KSO_{4150}	194	93	**
V6	P_{100}+KCl_{100}	161	60	-
V7	P_{100}+KSO_{4100}	147	46	-
V8	P_{100}+KCl_{150}	139	38	-
V9	P_{100}+KSO_{4150}	176	75	*
V10	N_{100}+ P_{100}+KCl_{100}	218	117	***
V11	N_{100}+ P_{100}+KSO_{4100}	237	136	***
V12	N_{100}+ P_{100}+KCl_{150}	194	93	**
V13	N_{100}+ P_{100}+KSO_{4150}	198	97	**
V14	KCl_{100}	174	73	*
V15	KSO_{4100}	153	52	-
V16	KCl_{150}	142	41	-
V17	KSO_{4150}	152	51	-

LSD 5% - 60.5 *LSD1% - 81.1* *LSD0.1% - 105.7*

Table 2

Interpretation - Alluvial soil

Treatments	Treatments	Mean, (g/pot)	Dif., (g/pot)	Significance
V1	Control	73	Mt	-
V2	N_{100}+KCl_{100}	102	29	***
V3	N_{100}+KSO_{4100}	106	33	***
V4	N_{100}+KCl_{150}	99	26	***
V5	N_{100}+KSO_{4150}	100	27	***
V6	P_{100}+KCl_{100}	88	15	**
V7	P_{100}+KSO_{4100}	85	12	*
V8	P_{100}+KCl_{150}	91	18	***
V9	P_{100}+KSO_{4150}	88	15	**
V10	N_{100}+ P_{100}+KCl_{100}	120	47	***
V11	N_{100}+ P_{100}+KSO_{4100}	115	42	***
V12	N_{100}+ P_{100}+KCl_{150}	105	32	***
V13	N_{100}+ P_{100}+KSO_{4150}	119	46	***
V14	KCl_{100}	88	15	**
V15	KSO_{4100}	89	16	**
V16	KCl_{150}	78	5	-
V17	KSO_{4150}	87	14	*

LSD5% - 10.1 *LSD1% - 13.4* *LSD0.1% - 17.5*

The analysis of data in table 2 regarding the obtained yields with the carrot crop grown on **Alluvial soil** shows that the yields varied between 73 g/pot in the case of the control and 120 g/pot in the case of the $N_{100}+P_{100}+KSO_{4100}$, treatment, and, from the statistical viewpoint, as compared to the control:

- V2, V3, V4, V5, V8, V10, V11, V12 and V13 treatments obtained very significant yield increases;
- V6, V9, V14 and V15 treatments obtained distinctly significant yield increases; and
- V7 and V17 treatments obtained significant yield increases.

Measurements regarding the diameter and length of roots have been carried out, performing a cubage of roots, where the highest yields are confirmed for the same treatments above mentioned (Tables 3 and 4).

Table 3

Biometrical data of carrot on Alluvial soil

No.	Treatments	r1			r2	
		Φ (mm)	*L (mm)*	*V (cm^3)*	*Dif. (cm^3)*	*Signif.*
V1	Control	9.75	102.75	996.5	*Mt*	
V2	$N_{100}+KCl_{100}$	10.05	120.25	1201.5	*205.00*	-
V3	$N_{100}+KSO_{4100}$	10.55	137.5	1458	*461.50*	***
V4	$N_{100}+KCl_{150}$	11.75	117.25	1372	*375.50*	**
V5	$N_{100}+KSO_{4150}$	10.88	108.75	1183.3	*186.75*	-
V6	$P_{100}+KCl_{100}$	10.93	97	1058	*61.50*	-
V7	$P_{100}+KSO_{4100}$	10.18	83.25	853	*-143.50*	-
V8	$P_{100}+KCl_{150}$	8.78	103.25	900	*-96.50*	-
V9	$P_{100}+KSO_{4150}$	10.5	91.75	953.75	*-42.75*	-
V10	$N_{100}+P_{100}+KCl_{100}$	12.38	132	1611.5	*615.00*	***
V11	$N_{100}+P_{100}+KSO_{4100}$	11.63	105.5	1230.3	*233.75*	-
V12	$N_{100}+P_{100}+KCl_{150}$	11.65	117	1350.8	*354.25*	**
V13	$N_{100}+P_{100}+KSO_{4150}$	11.5	115.25	1327.5	*331.00*	*
V14	KCl_{100}	9.98	101.5	1015	*18.50*	-
V15	KSO_{4100}	9.48	101	952.25	*-44.25*	-
V16	KCl_{150}	9.38	91.5	848	*-148.50*	-
V17	KSO_{4150}	8.78	95.5	840.75	*-155.75*	-

LSD5% - 249.400 LSD1% - 334.027 LSD0.1% - 435.829

The analysis of data in table 3, under the ***Alluvial soil*** conditions, shows that:

- the diameter of carrot roots varies between 8.78 mm in the case of V8 treatment and 12.38 mm in the case of V10 treatment;
- the length of carrot roots varies from 91.5 mm in the case of V16 şi 137.5 mm in the case of V3;

- volume of roots varies from 840.7 cm^3 in the case of V17 treatment to 1611.5 cm^3 in the case of V10 treatment.

From the statistical viewpoint, the fertilization with N_{100}+K_2SO_{4100} and N_{100}+ P_{100}+KCl_{100} determined very significant changes of these biometrical parameters, that is, 1458 cm^3, and 1611.5 cm^3, respectively.

Table 4

Biometrical data of carrot on Cambic chernozem

No.	Treatments	r1			r2	
		Φ (mm)	*L (mm)*	*V (cm^3)*	*Dif. (cm^3)*	*Signif.*
V1	Control	16.88	178.50	3029.50	0.00	-
V2	N_{100}+KCl_{100}	19.35	213.00	4123.00	1093.50	**
V3	N_{100}+KSO_{4100}	21.03	215.00	4527.50	1498.00	***
V4	N_{100}+KCl_{150}	19.55	205.75	4031.75	1002.25	*
V5	N_{100}+KSO_{4150}	20.38	209.25	4268.00	1238.50	**
V6	P_{100}+KCl_{100}	16.43	182.50	3034.50	5.00	-
V7	P_{100}+KSO_{4100}	15.35	168.50	2670.25	-359.25	-
V8	P_{100}+KCl_{150}	16.25	172.50	2821.50	-208.00	-
V9	P_{100}+KSO_{4150}	18.05	186.00	3357.75	328.25	-
V10	N_{100}+ P_{100}+KCl_{100}	20.45	214.00	4380.25	1350.75	**
V11	N_{100}+ P_{100}+KSO_{4100}	21.25	211.25	4489.50	1460.00	***
V12	N_{100}+ P_{100}+KCl_{150}	21.58	224.00	4847.25	1817.75	***
V13	N_{100}+ P_{100}+KSO_{4150}	19.78	224.00	4446.75	1417.25	***
V14	KCl_{100}	17.8	162.00	2899.50	-130.00	-
V15	KSO_{4100}	16.53	170.50	2809.50	-220.00	-
V16	KCl_{150}	16.5	168.00	2765.75	-263.75	-
V17	KSO_{4150}	15.93	154.75	2536.25	-493.25	-

LSD5% - 785.152 LSD1% - 1051.572 LSD0.1% - 13720.058

The analysis of data in table 4, under the ***Chernozem*** conditions, shows that:

- the diameter of carrot roots varies between 15.35 mm in the case of V7 treatment and 21.58 mm in the case of V12 treatment;

- the length of carrot roots varies from 154.75 mm in the case of V17 to 224 mm in the case of V3;

- volume of roots varies from 2536.25 cm^3 in the case of V17 treatment to 4847,25 cm^3 in the case of V12 treatment.

From the statistical viewpoint, fertilization with N_{100}+KSO_{4100} and N_{100}+ P_{100}+KCl_{100} determined very significant changes of these biometrical parameters, that is, 1817.75 cm^3, and 1498.0 cm^3, respectively.

Table 5

Qualitative results (carotene)
Determination of total carotene (mg/fresh product)

No. treatm.	CZ			AS		
		Dif.	Signif.		Dif.	Signif.
V1	12.86	CT		10.53	CT	
V2	14.75	1.19	*	9.60	-0.93	-
V3	14.55	1.69	*	11.46	0.93	-
V4	12.92	0.06	-	12.56	2.23	*
V5	14.48	1.62	*	11.58	1.05	-
V6	11.76	-1.10	-	11.34	0.81	-
V7	14.54	1.69	*	11.28	0.76	-
V8	15.30	2.45	*	10.70	0.17	-
V9	15.78	2.93	**	10.54	0.01	-
V10	14.67	1.81	*	10.31	-0.22	-
V11	14.96	2.11	*	10.53	0.00	-
V12	11.61	-1.25	-	10.03	-0.50	-
V13	12.24	-0.62	-	11.59	1.07	-
V14	12.93	0.07	-	11.85	1.33	*
V15	15.30	2.45	*	9.33	-1.20	-
V16	10.86	-2.00	-	12.08	1.55	-
V17	12.35	-0.50	-	10.35	-0.18	-
CZ				AS		
	LSD5%	*1.358*			*1.158*	
	LSD1%	*2.498*			*3.230*	
	LSD0.1%	*3.868*			*4.519*	

Under the **Alluvial soil** conditions, the total carotene content (fresh product) varied from 9.33 mg in the case of V15 treatment to 12.56 mg in the case of V4 treatment, while, under the **Chernozem** conditions, this varied from 10.86 mg in the case of V16 treatment to 15.3 mg in the case of V8 and V15 treatments.

Under the **Alluvial soil** conditions, the total carotene content (dry product) varied from 74.27 mg in the case of V12 treatment to 104.25 mg in the case of V4 treatment, while, under the **Chernozem** conditions, this varied from 82.72 mg in the case of V6 treatment to 119.65 mg in the case of V15 treatment.

The analysis of the results obtained with the both soil types shows clear differences as concerns the total carotene content firstly between the two soil types and then between the treatments.

Table 6

Qualitative results (carotene)
Determination of total carotene (mg/dry product)

No. treatm.	CZ			AS		
		Dif.	Signif.		Dif.	Signif.
V1	92.65			82.51		
V2	114.92	22.27	-	74.79	-7.72	-
V3	117.00	24.35	-	87.88	5.36	-
V4	104.39	11.74	-	104.25	21.74	**
V5	119.65	27.00	*	92.16	9.65	-
V6	82.72	-9.93	-	90.04	7.53	-
V7	103.76	11.11	-	81.17	-1.34	-
V8	118.30	25.65	*	92.04	9.53	-
V9	104.87	12.22	-	75.80	-6.71	-
V10	113.81	21.16		84.20	1.69	-
V11	112.95	20.30		81.88	-0.63	-
V12	88.46	-4.19		74.27	-8.24	-
V13	96.81	4.16		94.10	11.59	
V14	93.65	1.00		97.47	14.96	*
V15	112.84	20.19		74.69	-7.83	-
V16	88.63	-4.02		91.73	9.22	-
V17	88.77	-3.88		81.53	-0.98	-
CZ				AS		
	LSD5%	*25.367*			*12.115*	
	LSD1%	*33.975*			*19.959*	
	LSD0.1%	*44.330*			*26.395*	

CONCLUSIONS

1. The yields are clearly higher in the case of the Chernozem as compared with the Alluvial soil; the highest yields have been obtained with both soils at the V10, V11, V12 and V13 treatments followed by the V2, V3, V4 and V5, where nitrogen fertilizers were applied, biometrical measurements revealed the same results.
2. The quality of carrot roots is emphasized by the total carotene content, the differences being significant in the case of the Chernozem as compared to the Alluvial soil; and a clear differentiation is observed at the V11 and V13 treatments receiving $N_{100}+P_{100}+KSO_{4100}$ *si* $N_{100}+P_{100}+KSO_{4150}$ in the case of the both soil types.

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