INFLUENCE OF PHASAL FERTILIZATION ON THE SOIL FERTILITY, NUTRITIVE BALANCE AND PRODUCTION, AT A CROP OF CUCUMBERS PRODUCED IN VEGETATION POTS

INFLUENŢA FERTILIZĂRILOR FAZIALE ASUPRA STĂRII DE FERTILITATE A SOLURILOR, BALANŢEI NUTRITIVE ŞI PRODUCŢIILOR, LA O CULTURĂ DE CASTRAVEŢI, PRODUSĂ ÎN VASE DE VEGETAŢIE

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Abstract. *A primary factor in achieving higher production to crops, along with other vegetation factors, is the fertilization. For the vegetable crops where production system is intensive, it is frequently used the additional fertilization, using solid or liquid fertilizers as radicular or foliar application. The supplementary fertilizations made in the period of intensive growth and on the background of a basic fertilization judiciously set, create in soil the stabilization of the nutritive balance, resulting in increased production. In this context, at the culture of cucumbers under study, on an plot of 250 Kg / ha active substance NPK, the use of F_{221} foliar and of the urea administered to the soil, in 2 successive pheno-phases led to a content of the accessible forms of nutrients of 47 ppm nitrate ammonia nitrogen and, 45 ppm accessible phosphorus and 204 ppm accessible potassium in the soil. These insurance levels in the soil correlate with content of total forms of nutrients from the plant in the bloom phenol-phase, 5.1, 0.45 and 5.1% nitrogen, total phosphorus and potassium. The productions obtained with the same formula fertilization is situated at 51000 kg / ha, statistically assured. The comparative results are obtained by using F_{221} and ammonium nitrate in the same pheno-phases, respectively crops of 49800 kg / ha, but with slightly lower production increases.*
Cuvinte cheie: foliar fertilizer, plot, nutritive elements

Rezumat. *Un factor primordial în obținerea unor producții superioare la culturile agricole, alături de ceilalți factori de vegetație, îl reprezintă fertilizarea. Pentru culturile legumicole, unde sistemul de producție este unul intensiv, se recurge în mod deosebit la fertilizări suplimentare, utilizând îngrăşăminte solide sau lichide, administrate radicular sau foliar. Fertilizările suplimentare, practicate în perioadele de creştere intensă şi pe fondul unei fertilizări de bază judicios stabilite cantitativ, crează în sol stabilizarea elementelor de nutriție în jurul valorilor optime iar în plantă, conduc la echilibrarea balanței nutritive, soldate cu creşterea producțiilor. În acest context, la cultura de castraveți luată în studiu, pe un agrofond de 250 Kg/ha subtanță activă NPK, utilizarea foliarului F_{221} şi a ureei administrate la sol, în 2 fenofaze succesive, a condus în sol la un conținut al*

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formelor accesibile de elemente nutritive de 47 ppm azot nitric şi amoniacal, 45 ppm fosfor accesibil şi 204 ppm potasiu accesibil. Aceste nivele de asigurare în sol se corelează cu conţinutul de forme totale de elemente nutritive din plantă în fenofaza de inflorire, de. 5,1; 0,45 şi 5,1 % azot, fosfor şi potasiu total. Producţiile obţinute cu aceeaşi formulă de fertilizare se situează la 51000 kg/ha, asigurate statistic. Rezultate comparative se obţin şi prin utilizarea F_{221} şi a azotatului de amoniu, în aceleaşi fenofaze, respectiv recolte de 49800 kg/ha, însă cu sporuri de producţie uşor mai scăzute.

Cuvinte cheie: îngrăşământ foliar, agrofond, elemente nutritive

INTRODUCTION

The varying requirements of plant crops for nutrients during the growing season requires the application of fertilizers in several phases, taking into account the rhythm of assimilation and the amount of nutrients required by some phenol-phases, the root system and not least the increase of the degree of fertilizers used. The mineral nutrition during the growing season can become, in some cases, one of the main ways of meeting the requirements in nutrients (Davidescu, 1992). In particular at the cucurbit crops, the vegetation can be administered 4-5 additional fertilization in different phenological phases such as early flowering, early binding of fruits, early ripening fruit first, etc. In these phenological phases and at these species, the nitrogen and potassium requirements are quite high (Budoi, 2001). Correcting the nutrition deficiencies through foliar diagnosis but also by analyzing the status of soil fertility in conjunction with the specific consumption of plants but also with a series of agri-eco-pedological factors, constitutes systemic approaches of establishing the dosage, reports and varieties of fertilizers, within a culture technology (Volf, 2008).

MATERIAL AND METHOD

Experience was conducted in the green house of the Department of Agricultural Chemistry, UASVM Iasi, along three years, 2013-2015, using cucumbers, Korinda F_1 hybrid. The experimental scheme was designed in blocks with three repetitions on variations and had two impact factors into study:

- Factor A – plot of fertilization, with graduations:
  a_0 – Mt, unfertilized, a_1 – plot 150 kg/ha active substance, a_2 – plot 200 kg/ha active substance, a_3 – plot 250 kg/ha active substance.
- Factor B – additional fertilization with graduations:
  b_0 – Mt, nefertilizat, b_1 – F_{221}, b_2 - F_{221}+NH_4NO_3, b_3 - F_{221} + urea, b_4 - NH_4NO_3, b_5 – urea, b_6 – Fertcomplex, b_7 – Kristalon

For basic fertilization was used ammonium nitrate (34% a.s.), superphosphate concentrate (50% etc.) and calcium bicarbonate (40%), administered in a complexing report of 1: 0.4: 1.8 NPK, similar to that required balance ratio of NPK in the soil, needed for this species (Davidescu, 1992).

For the additional soil and foliar fertilizations there were used NH_4NO_3 and urea (100 kg / ha) and F_{221}, Fertcomplex and Kristalon (3-7 L / ha a. s.) with a varied chemical composition, administered in two divided phenol-phases of vegetation, at 5-7 leaves and before blooming (tab. 1).

Table 1

Chemical composition of foliar fertilizers

Foliar fertilizer	CSA %	pH	N g/L	P g/L	K g/L	B g/L	S g/L	Mn g/L	Mg g/L	Zn g/L	Cu g/L	Fe g/L	Mo g/L
F_{221}	16	6.5-7	70	70	48	0.2	9	0.2	0.5	0.1	0.05	0.2	-
Fertcomplex	16	6.5	80	80	75	0.3	0.4	0.4	0.04	0.04	0.1	0.3	0.03
Kristalon	16	6.6	180	180	180	0.025	-	0.04	-	0.025	0.01	0.07	0.004

The soil used in the vegetative pots was a cambic chernozem with a light texture, a slightly acid pH (6.7) and a state of medium fertility.

Prior to setting up the cultures and at the end of vegetation, soil samples were taken and subjected to laboratory analyses. For the foliar diagnosis, before flowering there were taken samples of limb that were prepared and analyzed in the laboratory. At harvest there were performed various biometric measurements, namely the average weight of fruits / plant (g), average plant height (cm), the average diameter of plant (cm).

For the statistic calculation of yields, it was established a density of 24,000 plants / ha.

The working methods were in accordance with the ones elaborated by I.C.P.A. Romania for agrochemical analyses. There were made the following determinations:

For soil: content of assimilable nitrogen (ammoniacal) in KCl 0.1 N extract, Colourimetric method, with Nessler reactive; content of nitric nitrogen (NO_3^-), in KCl 0.1 N extract, Colourimetric method with fenoldisulfonic acid; content of potentially assimilable phosphor, Egner - Riehm - Domingo (P-AL) Method; content of assimilable potassium, in plugged solutions extract, Egner - Riehm - Domingo (K - AL) Method.

For plants: dosage of total nitrogen, variant mineralized with sulfuric acid, distillation and titration with H_2SO_4; dosage of total phosphorous – mineralization on wet way, with ammonium molibdate and reduction with stanium colure, colorimetric dosage (after Nicolov, 1976); dosage of total potassium, by mineralization with a mixture of sulfuric and perchloric acid.

RESULTS AND DISCUSSIONS

The dosage of nutritive elements in accessible forms revealed that their quantitative level in the soil is in close accordance with the plot used but also with the chemical composition of fertilizers used at the additional fertilization (tab. 2).

Due to the increase of doses at the basic fertilization and by administering phasal fertilizations in the formula F_{221} + NH_4NO_3 and F_{221} + urea, it was noticed an intake of mobile forms in soil, reaching for the plot of 250 kg / ha a.s. at 44 and 47 ppm nitric nitrogen + ammonium nitrogen, 46 and 45 ppm P-AL and respectively 201 and 202 ppm K-AL. The values are considered optimal for nitrogen, phosphorous and normal moderate to high for potassium.

Table 2

Influence of fertilization on the accessible forms of nitritive elements

Variant/plot	150 kg/ha active substance			200 kg/ha active substance			250 kg/ha active substance		
	NH_4+NO_3 ppm	P_2O_5 ppm	K_2O ppm	NH_4+NO_3 ppm	P_2O_5 ppm	K_2O ppm	NH_4+NO_3 ppm	P_2O_5 ppm	K_2O ppm
Control	8	11	102	8	11	102	8	11	102
F_{221}	18	23	165	28	33	175	32	40	195
$F_{221}+NH_4NO_3$	22	25	172	35	35	183	44	46	201
F_{221} + urea	23	24	169	36	34	182	47	45	204
NH_4NO_3	20	24	163	32	36	179	43	44	202
urea	21	23	165	33	32	184	45	45	200
Fertcomplex	20	20	174	31	34	180	36	43	198
Kristalon	18	22	173	29	32	181	34	45	199

The trend of evolution of nutritive elements form the plant under the influence of fertilizations somehow follows the balance of determined accessible elements in the soil. It was noticed a considerable increase in the content of macronutrients in the plants from the plot of 150 kg/ha a.s/. and to the plot of 250 kg/ha a.s., in all variants of additional fertilization. In the same trend there are registered the increases compared to the unfertilized control variant, thus finding a progression of these values in comparison to the doses of fertilizers used and their chemical composition (tab. 3). The formulas of additional fertilization F_{221} and F_{221} + NH_4NO_3 + urea attract a content of 4.8, 0.40 and 4.9% nitrogen, total phosphorus and potassium, and respectively 5.1, 0.45 and 5.1% in plant material for the plot of 250 kg/ha a.s. but also the administration of singular Kristalon, on the same plot reaches values of 5.2, 0.45 and 4.9% nitrogen, phosphorus and potassium, total forms, values that, in all cases, falls in the optimum – slightly elevated category.

Table 3

Influence of fertilization on the evolution of total forms of nutritive elements from the vegetal material

Variant/ plot	150 kg/ha active substance			200 kg/ha active substance			250 kg/ha active substance		
	N_t %	P_t %	K_t %	N_t %	P_t %	K_t %	N_t %	P_t %	K_t %
Control	2.9	0.35	3.7	2.9	0.35	3.7	2.9	0.35	3.7
F_{221}	3,9	0.35	3.9	4.1	0.41	4.1	4.5	0.40	4.1
$F_{221}+NH_4NO_3$	4.4	0.40	4,2	4.5	0.45	4.5	4.8	0.40	4.9
F_{221} + urea	5.2	0.47	4.7	5.0	0.45	4.9	5.1	0.45	5.1
NH_4NO_3	4.7	0.42	4.1	4.9	0.40	4.6	5.0	0.40	4.5
urea	4.6	0.42	4.0	4.6	0.46	4.1	4.9	0.39	4.1
Fertcomplex	4.8	0.44	3.9	4.9	0.43	4.2	5.0	0.42	4.3
Kristalon	5.0	0.49	4.2	5.0	0.44	4.5	5.2	0.45	4.9

The biometric characteristics determined point out notable increases in comparison to the plot used and type of fertilizer used at the additional

fertilizations (tab. 4). It stood out the F_{221} + urea variant, on the plot of 250 kg/ha a.s. NPK, at all biometric indicators analyzed, respectively 4125 gr fruit/pl, a average length of the plant of 110 cm and a average fruit diameter of 5.5 cm.

Table 4

Influence of fertilizations on the biometric characteristics

Variant/plot	150 kg/ha active substance			200 kg/ha active substance			250 kg/ha active substance		
	Av. weight fruit/pl (g)	Av. length. pl (cm)	Ø fruit (cm)	Av. weight fruit/pl (g)	Av. length. pl (cm)	Ø fruit (cm)	Av. weight fruit/pl (g)	Av. length. pl (cm)	Ø fruit (cm)
Control	1125	22	3.5	1125	22	3.5	1125	22	3.5
F_{221}	1255	26	3.9	1315	59	4.5	1390	90	4.8
F_{221}+NH_4NO_3	1530	32	4.8	1860	55	5.2	2075	98	5.4
F_{221} + urea	1600	33	5.0	1925	56	5.3	4125	110	5.5
NH_4NO_3	1410	31	4.4	1675	54	5.1	1890	77	5.3
urea	1450	32	4.7	1780	55	5.1	1925	78	5.4
Fertcomplex	1320	28	4.3	1405	49	4.7	1540	61	5.0
Kristalon	1290	27	4.5	1430	49	4.8	1530	69	5.1

The production obtained in the three years of experimentation are statistically assured, at significant and distinctly significant level, for all three plots, by using additional fertilization, in formulas F_{221} +NH_4NO_3, F_{221} + urea, NH_4NO_3 and urea (tab. 5).

Table 5

Influence of basic and additional fertilization on production

Variant/ plot.	150 kg/ha active substance				200 kg/ha active substance				250 kg/ha active substance			
	Prod. kg/ha	%	Dif. ±kg/ha	Sem.	Prod. kg/ha	%	Diff. ±kg/ha	Sem	Prod. kg/ha	%	Diff. ±kg/ha	Sem
Control	27000	100	-	-	27000	100	-	-	27000	100	-	-
F_{221}	30120	112	+3120	-	31560	117	+4560	-	33360	123	+6360	-
F_{221}+ NH_4NO_3	36720	136	+9720	*	44640	165	+17640	**	49800	184	+22800	**
F_{221} + urea	38400	142	+11400	*	46200	171	+19200	**	51000	189	+24000	**
NH_4NO_3	33840	125	+6840	-	40200	149	+13200	*	45360	168	+18360	**
urea	34800	129	+7800	*	42720	158	+15720	*	46200	171	+19200	**
Fertcomplex	31680	117	+4680	-	33720	125	+6720	-	36960	137	+9960	-
Kristalon	30960	115	+3960	-	34320	127	+7320	-	36750	136	+9750	-

DL 5% = 7435 kg/ha = 9870 kg/ha = 11340 kg/ha
DL 1% = 14320 kg/ha = 16200 kg/ha = 17565 kg/ha
DL 0.1% = 22210 kg/ha = 24535 kg/ha = 26540 kg/ha

In the variants of additional combined fertilization (radicular + foliar) F_{221} + NH_4NO_3 F_{221} + urea there are obtained productions of 49800 respectively 51000 kg/ha cucumber, with an increase of production compared to the unfertilized plot of 22800 kg and 24000 kg, to the variants of additional radicular fertilization only with NH_4NO_3 and urea, in which the productions although statistically insured at a significantly distinct level, it registered lower values of 45 360 and 46200 kg/ha, respectively.

CONCLUSIONS

1. The efficiency of the fertilization system, reflected in the assurance status of the soil with nutrients, in accordance with the balance nutritious plant but especially in production levels is higher when there are taken into consideration the chemical characteristics of fertilizers used and their differentiated application, depending on the condition of soil fertility and biological and physiological peculiarities of the species.

2. In all fertilization variants we could notice an increasing trend of insurance of the soil condition with NPK accessible forms, a condition of the total NPK forms in the plant but also of the yields compared to unfertilized control variant in relation to the dose of basic fertilizer and with the nature of administered fertilizer.

3. At the culture of cucumbers, on a ground of nutritive elements judiciously set, the fractional administration of doses of supplementary fertilizers, for the critical moment of nutrition, leads at getting impressive increases of production, regardless of how it is applied alone or combined.

4. The F_{221} foliar, in combination with nitrogen fertilizers radicularly administered, determines the largest productions in the conditions of a basic fertilization of 250 kg/ha NPK a.s, respectively 49800 and 51000 kg/ha cucumber.

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