

# Fertilization optimization in the case of the gared potato variety through superior valorization of the Romanian chemical fertilizers in the Tg. Secuiesc depression

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**Abstract** Profitable potato cultures cannot be developed without chemical and/or organic fertilization. The fertilization must assure the best possible valorization of the intensive varieties' production potential under the ecological conditions existing in the cultivation region.

The experiments took place at the Potato Research and Cultivation Station Targu Secuiesc in the period 2008-2010, in this paper we presents the partial results of 2009 year.

Our research proposed this approach to the aspects of potato fertilization in the case of the Gared variety, created at the Potato Research and Cultivation Station Targu Secuiesc.

To achieve a higher production level, 4 levels of fertilization and 2 types of fertilizers were studied.

**Key words**

fertilization, variety, potato, nitrogen doses

Profitable potato cultures cannot be developed without chemical and/or organic fertilization. The fertilization must assure the best possible valorization of the intensive varieties' production potential under the ecological conditions existing in the cultivation region [2,3].

The potato plant, in the first period after planting until it reaches approx. 200 cm<sup>2</sup> of leaf area, extracts the necessary nutrients needed for growth at 96% from the mother tuber and only 4 % from the soil. At first, the input level of nutrient uptake is very low, it

is a process that intensifies rapidly, reaching a maximum at the beginning to full flower, when dry matter accumulation is the most intense. The fertilization optimization will be achieved according to the type of fertilizer used, the applied dose and the rate of absorption of key nutrients. [4,5,6,7].

**Material and Research Method**

**Experimental factors**

Factor A – type of fertilizer (NPK ratio)	Factor B – nitrogen level (s.a. kg /ha)	Factor C – epoca de plantare
a <sub>1</sub> - Complex 11:9:20 (N 90 kg s.a./ha : P 90 kg s.a./ha : K 90 kg s.a./ha)	b <sub>1</sub> – N 50	c <sub>1</sub> - Early (at the beginning of April)
	b <sub>2</sub> – N 100	
a <sub>2</sub> - Complex 15:15:15 (N 137 kg s.a./ha : P 112 kg s.a./ha : K 250 kg s.a./ha)	b <sub>3</sub> – N 150	c <sub>2</sub> - Late (at the end of April)
	b <sub>4</sub> – N 200	

The experiment was located after subdivided parcels method in 3 repetitions.

As biological material we used the *Gared* variety, which are in Base Class Super Elite biological category.

The plantation was performed semi-mechanized, the planting distance being 75/25 cm, thus creating a density of 53.300 plants/ha.

Chemical fertilizers were applied at the time of the seedbed preparation.

Observations were carried out during the vegetation period with reference to:

- ✓ the date of the main agrophytotechnical works;
- ✓ the dates of the main phenophases;
- ✓ the number of planting holes in the two middle rows;
- ✓ the harvest was carried out according to variants and repetitions;
  - ⊙ number and weight of tubers < 55 mm
  - ⊙ number and weight of tubers 35-55 mm
  - ⊙ number and weight of tubers > 35 mm

The calculation and interpretation of results was carried out according to the method of variance

analysis, and for the appreciation of the significance of differences it was used the test of multiple comparisons (Duncan).

### Biological material used in the study

The biological material used during the experimental years of 2008, 2009, 2010 falls within the Base Class Super Elite biological category.

### Potato variety used in the study are:



*GARED* variety

*Gared* potato variety was created at S.C.D.C Tg. Secuiesc, and homologated in 2004 and certified in 2009.

**Morphological characters:** the plant is vigorous with a large number of stems and belongs to foliage type. The leaves have a medium size with light – green color. The flowers have a medium size, having a violet color with white points. The tubers have a short oval shape with shallow eyes. The color of skin is red and the color of flesh is cream. The sprouts have a conic shape with middle size and red – violet colors on the base of sprouts. The bud of sprout on light is half open and porosity is dense to very dense.

**Vegetation period:** *Gared* variety belongs to the group of late varieties, with a vegetation period of over 110 days.

**Yielding capacity:** it is a high-yielding potato variety with a yield of over 67.0 tones/ha.

**Culinary quality:** is good and belongs to B class. *Gared* variety is very suitable for pommes frites production. The content of starch is over 21%.

**Resistance to diseases and pest:** *Gared* variety is resisting to late blight on leaves and tubers, is resisting to leave roll virus (PLRV) and tolerant to virus (PVY). It is resisting to potato cyst nematodes (*Globodera rostochiensis*) and black wart (*Synchytrium endobioticum*).

### Fertilizers applied in the experiment

**Ammonium nitrate** it has got 33.0-34.5% nitrogen content, most frequently of 33.5%. It appears in the form of a crystallized or granulated salt of white, sometimes pink-yellowish color, it is water-soluble and very hygroscopic. It can be applied on every type of soil, but with restrictions on soils with an acidic reaction.

**The Complex Fertilizer 15-15-15** it is a mineral compound that contains three nutritive elements:

nitrogen, phosphorus and potassium. The identification code of these fertilizers is conventionally based on the individual size of the components. This type of fertilizer contains 15% nitrogen, 15% phosphorus and 15% potassium.

**The Complex Fertilizer 9-11-20** it is a mineral compound that contains three nutritive elements: nitrogen, phosphorus and potassium.

## Results and Discussions

### Results concerning the effects and the interaction of planting times, of the basic fertilization with N:P:K and of the nitrogen doses applied at planting on the production of the *Gared* variety

Under the experimental conditions in 2009 in the case of the *Gared* variety the total average

production was 42,9 t/ha, from which 26,2 t/ha were tubers larger than 55 mm (**Table 1**).

At early planting time has been achieved an increase of 4,8 t/ha in the production as compared to the late planting time, due to the significant growth of 9,3 t/ha recorded in the production of medium sized tubers, because the production rate of large sized tubers was significantly low (6,2 t/ha).

Due to the basic fertilization with 1250 kg/ha C11:11:20 has been achieved a production increase of 9,6 t/ha in comparison with fertilization with 600 kg/ha C15:15:15. By this variant of basic fertilization there has been an increase in the production in all size fractions.

High levels of nitrogen applied at planting resulted in significant reduction in production, an average of 7,2 t/ha, mainly in the case of tubers larger than 55 mm.

Table 1

Effects and the interaction of planting times, of the basic fertilization with N:P:K and of the nitrogen doses applied at planting on the production of the *Gared* variety

Planting Time	Basis fertilization	Ammonium nitrate kg s.a./ha	Tubers production of <i>Gared</i> variety							
			>55 mm		30 – 55 mm		<30 mm		Total	
			t/ha	Duncan Test /Dif.	t/ha	Duncan Test /Dif.	t/ha	Duncan Test /Dif.	t/ha	Duncan Test /Dif.
I	C11:9:20 1250 kg/ha	50	37,9	A	8,7	D	1,2	A	47,8	B
		100	27,4	C	9,8	CD	1,3	A	38,6	CD
	C15:15:15 600 kg/ha	150	23,4	D	13,2	BCD	1,6	A	38,1	CD
		200	28,5	BC	7,5	D	1,4	A	37,4	CD
II	C11:9:20 1250 kg/ha	50	32,0	B	20,5	AB	3,7	A	56,2	A
		100	21,4	D	22,8	A	3,9	A	48,1	B
	C15:15:15 600 kg/ha	150	23,9	D	17,8	ABC	2,4	A	44,1	BC
		200	15,0	E	15,2	ABCD	2,8	A	33,0	D
<b>Media</b>										
<b>Planting time 1 – 15 april</b>			<b>23,1</b>	<b>-6,2°</b>	<b>19,1</b>	<b>+9,3*</b>	<b>3,2</b>	<b>+1,8*</b>	<b>45,3</b>	<b>-</b>
<b>Planting time 2 – 25 april</b>			<b>29,3</b>	<b>-</b>	<b>9,8</b>	<b>-</b>	<b>1,4</b>	<b>-</b>	<b>40,5</b>	<b>- 4,8*</b>
<b>C15:15:15 – 600 kg/ha</b>			<b>22,7</b>	<b>-</b>	<b>13,4</b>	<b>-</b>	<b>2,0</b>	<b>-</b>	<b>38,1</b>	<b>-</b>
<b>C11:9:20 – 1250 kg/ha</b>			<b>29,7</b>	<b>+7,8*</b>	<b>15,5</b>	<b>+2,1</b>	<b>2,5</b>	<b>+0,5</b>	<b>47,7</b>	<b>+9,6*</b>
<b>NH<sub>4</sub>NO<sub>3</sub>– low level</b>			<b>29,3</b>	<b>-</b>	<b>15,0</b>	<b>-</b>	<b>2,2</b>	<b>-</b>	<b>46,5</b>	<b>-</b>
<b>NH<sub>4</sub>NO<sub>3</sub>– high level</b>			<b>23,1</b>	<b>-6,2°</b>	<b>13,8</b>	<b>-1,2</b>	<b>2,3</b>	<b>+0,1</b>	<b>39,5</b>	<b>-7,2°</b>
<b>Average / variety</b>			<b>26,2</b>		<b>14,4</b>		<b>2,3</b>		<b>42,9</b>	

DL 5% (planting time\*.basis fert \*

NH<sub>4</sub>NO<sub>3</sub>) **3,5 t/ha**      **7,7 t/ha**      **2,4 t/ha**      **7,8 t/ha**

DL 5% (planting time) **4,9 t/ha**      **4,6 t/ha**      **0,6 t/ha**      **2,7 t/ha**

DL 5% (basis fertilization) **4,2 t/ha**      **1,5 t/ha**      **0,5 t/ha**      **4,4 t/ha**

DL 5% (ammonium nitrate) **1,3 t/ha**      **2,7 t/ha**      **0,9 t/ha**      **2,8 t/ha**

The calculations indicate significant interaction between the planting time and the fertilization. Highest yields in the case of both planting times (47,8 t/ha respectively 56,2 t/ha) when fertilized with C11:9:20 - 1250 kg/ha and 50 kg/ha nitrogen .

The highest production of tubers having size larger than 55 mm in diameters (37,9 t/ha) has been achieved with the same fertilizer combination, but only in the case of earlier planting. Production of tubers, fraction of 30-55 mm diameter, was influenced only by the planting-date, being higher in the case of late

planting-date. Production of tubers smaller than 30 mm (1,2-3,9 t/ha) was not significantly influenced by the interaction of planting date and fertilization.

### Results concerning the effects and the interaction of planting times, of the basic fertilization with N:P:K and of the nitrogen doses applied at planting on the number of tubers in the case of the *Gared* variety

The average number of tubers used in the experiment was 52,5 pc/sm, of which 17,0 pc/sm tubers larger than 55 mm, 20,1 pc/sm tubers of 30-55 mm and 15,4 pc/sm tubers smaller than 30 mm.

Late planting was unfavorable for tuber formation, their average number being 44,1 pc/sm compared to 60,8 pc/sm of tubers planted in the early planting period. The higher number of tubers in the early planting time was due to the small and medium-sized tubers, but the number of large-sized tubers was significantly lower than in the late planting time. The basic fertilization with C11:9:20 - 1250 kg/ha significantly increased the total number of tubers (5,1 pc/sm), mainly the number of tubers larger than 55 mm (3,4 pc/sm), compared to fertilization with 600 kg/ha C15:15:15.

High nitrogen levels at planting resulted in a significant reduction in the number of tubers larger than 55 mm (-4,5 pc/sm) (Table 2).

Table 2

Effects and the interaction of planting times, of the basic fertilization with N:P:K and of the nitrogen doses applied at planting on the number of tubers in the case of the *Gared* variety

Planting Time	Basis fertilization	Ammonium nitrate kg s.a./ha	Tubers production of <i>Gared</i> variety							
			>55 mm		30 – 55 mm		<30 mm		Total	
			units / mp	Duncan Test /Dif.	units / mp	Duncan Test /Dif.	units / mp	Duncan Test /Dif.	units / mp	Duncan Test /Dif.
I	C11:9:20 1250 kg/ha	50	23,2	A	13,1	BC	10,1	BC	46,4	BC
		100	17,0	BC	15,6	BC	9,4	C	41,9	C
	C15:15:15 600 kg/ha	150	18,4	BC	20,4	AB	9,9	BC	48,7	BC
		200	15,9	C	12,4	C	11,4	BC	39,6	C
II	C11:9:20 1250 kg/ha	50	19,4	B	26,0	A	19,9	ABC	65,2	A
		100	15,2	C	27,9	A	23,6	A	66,7	A
	C15:15:15 600 kg/ha	150	16,0	C	20,8	AB	18,6	ABC	55,3	AB
		200	10,8	D	25,0	A	20,4	AB	56,2	AB
<b>Media</b>										
<b>Planting time 1 – 15 april</b>			<b>15,3</b>	<b>-3,3°</b>	<b>24,9</b>	<b>+9,6*</b>	<b>20,6</b>	<b>+10,4*</b>	<b>60,8</b>	<b>-</b>
<b>Planting time 2 – 25 april</b>			<b>18,6</b>	<b>-</b>	<b>15,3</b>	<b>-</b>	<b>10,2</b>	<b>-</b>	<b>44,1</b>	<b>-16,7*</b>
<b>C15:15:15 – 600 kg/ha</b>			<b>15,3</b>	<b>-</b>	<b>19,6</b>	<b>-</b>	<b>15,0</b>	<b>-</b>	<b>49,9</b>	<b>-</b>
<b>C11:9:20 – 1250 kg/ha</b>			<b>18,7</b>	<b>+3,4*</b>	<b>20,6</b>	<b>+1,0</b>	<b>15,7</b>	<b>+0,7</b>	<b>55,0</b>	<b>+5,1*</b>
<b>NH<sub>4</sub>NO<sub>3</sub>– low level</b>			<b>19,2</b>	<b>-</b>	<b>20,0</b>	<b>-</b>	<b>14,6</b>	<b>-</b>	<b>53,9</b>	<b>-</b>
<b>NH<sub>4</sub>NO<sub>3</sub>– high level</b>			<b>14,7</b>	<b>-4,5°</b>	<b>20,2</b>	<b>+0,2</b>	<b>16,1</b>	<b>+1,5</b>	<b>51,1</b>	<b>-2,8</b>
<b>Average / variety</b>			<b>17,0</b>		<b>20,1</b>		<b>15,4</b>		<b>52,5</b>	

DL 5% (planting time\*.basis fert \*  
NH<sub>4</sub>NO<sub>3</sub>)

DL 5% (planting time)	3,0 buc.	7,3 buc.	10,0 buc.	10,7 buc.
DL 5% (basis fertilization)	2,4 buc.	4,7 buc.	3,2 buc.	2,9 buc.
DL 5% (ammonium nitrate)	2,9 buc.	1,7 buc.	3,6 buc.	3,3 buc.
	1,1 buc.	2,6 buc.	3,5 buc.	3,8 buc.

The interaction between the factors studied is the most evident on the number of tubers larger than 55 mm, early planting produced maximum large tubers (23,2 pc/sm), when fertilized with C11:9:20 - 1250 kg/ha and applying a reduced nitrogen dose at planting. In the case of small tubers in these interaction planting time has stronger effects than the combined effects of fertilization on them.

### Results concerning the effects and the interaction of planting times, of the basic fertilization with N:P:K and of the nitrogen

### doses applied at planting on the average weight of tubers in the case of the *Gared* variety

According to the experiment in 2009 in the case of the *Gared* variety the average weight of the tubers was 83 g. The average weight was 154g in the case of tubers larger than 55 mm, 70 g in the case of tubers having a diameter of 30-55 mm, 14 g in the case of tubers smaller than 30 mm. Basic fertilization with C11:9:20 - 1250 kg/ha significantly increased (10g) the average weight of tubers. (Table 3).

Table 3

Effects and the interaction of planting times, of the basic fertilization with N:P:K and of the nitrogen doses applied at planting on the average weight of tubers in the case of the *Gared* variety

Planting Time	Basis fertilization	Ammonium nitrate kg s.a./ha	Tubers number of <i>Gared</i> variety							
			>55 mm		30 – 55 mm		<30 mm		Total	
			g	Duncan Test /Dif.	g	Duncan Test /Dif.	g	Duncan Test /Dif.	g	Duncan Test /Dif.
I	C11:9:20 1250 kg/ha	50	163	AB	66	ABC	12	A	103	A
		100	161	AB	63	C	14	A	92	ABC
	C15:15:15 600 kg/ha	150	132	C	64	BC	15	A	78	CD
		200	181	A	60	C	13	A	95	AB
II	C11:9:20 1250 kg/ha	50	165	AB	79	ABC	18	A	86	BCD
		100	141	BC	83	AB	16	A	73	D
	C15:15:15 600 kg/ha	150	150	BC	85	A	13	A	80	BCD
		200	140	BC	61	C	14	A	59	E
<b>Media</b>										
<b>Planting time 1 – 15 april</b>			<b>159</b>	<b>-</b>	<b>64</b>	<b>-</b>	<b>14</b>	<b>-</b>	<b>92</b>	<b>-</b>
<b>Planting time 2 – 25 april</b>			<b>149</b>	<b>-1°</b>	<b>77</b>	<b>+13*</b>	<b>15</b>	<b>+1*</b>	<b>74</b>	<b>-18°</b>
<b>C15:15:15 – 600 kg/ha</b>			<b>151</b>	<b>-</b>	<b>68</b>	<b>-</b>	<b>14</b>	<b>-</b>	<b>78</b>	<b>-</b>
<b>C11:9:20 – 1250 kg/ha</b>			<b>158</b>	<b>+7</b>	<b>73</b>	<b>+5</b>	<b>15</b>	<b>+1</b>	<b>88</b>	<b>+10*</b>
<b>NH<sub>4</sub>NO<sub>3</sub>– low level</b>			<b>152</b>	<b>-</b>	<b>74</b>	<b>-</b>	<b>15</b>	<b>-</b>	<b>87</b>	<b>-</b>
<b>NH<sub>4</sub>NO<sub>3</sub>– high level</b>			<b>156</b>	<b>+4</b>	<b>67</b>	<b>-7°</b>	<b>14</b>	<b>-1</b>	<b>80</b>	<b>-7°</b>
<b>Average / variety</b>			<b>154</b>		<b>70</b>		<b>14</b>		<b>83</b>	

DL 5% (planting time\*.basis fert \*

NH <sub>4</sub> NO <sub>3</sub> )	25 g	18 g	8 g	15 g
DL 5% (planting time)	22 g	11 g	1 g	4 g
DL 5% (basis fertilization)	16 g	6 g	4 g	8 g
DL 5% (ammonium nitrate)	9 g	6 g	3 g	5 g

The average weight of tubers was, however, significantly reduced due to the late planting (-18g/tuber) and the high fertilization levels (-7g/tuber).

The largest tubers were recorded in the early planting time when fertilized with C15:15:15 600 kg/ha and 200 kg N/ha at planting (181 g/tuber), and by both fertilizer combinations with C11:9:20 - 1250 kg/ha (161-163 g/tuber).

Basically the same average weight was recorded also in the second planting time by fertilizing with C11:9:20 - 1250 kg/ha and applying a reduced nitrogen dose at planting.

### Conclusions

- The highest yield in both planting periods in the case of the *Gared* variety was obtained when fertilized with C11:9:20 - 1250 kg/ha and applied 50 kg N/ha.
- Late planting significantly favored the tuber formation, their average number being 60,8 pc/sm compared to 44,1 pc/sm of tubers planted in the early planting date. The higher number of tubers in the second planting time was due to the small and medium-sized tubers, but the number of large-

sized tubers was significantly lower than in the early planting time.

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