

УДК 635.21:631.165



# YIELD STRUCTURE IN THE PRODUCTION OF CERTIFIED SEEDS FROM BULGARIAN POTATO VARIETIES

**Nacheva E.<sup>1</sup>** – Associate Professor, PhD, department «Breeding, Variety Maintenance and Introduction of Vegetable Crops»

**Blagoeva V.<sup>2</sup>** – Assistant, Potato Experimental Station

**Masheva S.<sup>1</sup>** – Professor PhD., department «Technologies in vegetable production»

**Michov M.<sup>1</sup>** – Professor PhD., department «Technologies in vegetable production»

**Yankova V.<sup>1</sup>** – Associate Professor PhD., department «Technologies in vegetable production»

**Iliev E.<sup>2</sup>** – Assistant, Potato Experimental Station

**Markova D.<sup>1</sup>** – Assistant, «Technologies in vegetable production»

<sup>1</sup>Maritsa Vegetable Crops Research Institute

32 Brezovsko shosse Str.4003, Plovdiv, Bulgaria Tel: 00359 32 95 12 27, E-mail:emnach@abv.bg

<sup>2</sup> Potato Experimental Station

170, Tzar Boris III Str.,Samokov, Bulgaria Tel: 00359 722 66181, E-mail: osk\_samokov@abv.bg

*The experiment was performed in the Maritsa Vegetable Crops Research Institute, Plovdiv and Experimental station, Samokov during the period 2009-2011. The aim of this study was to investigate yield structure in the production of certified seeds from Bulgarian potato varieties. Three factors field experiment was set with 12 combinations with established effect of the factors - fertilization rate, planting density and term of leaf striping on the yield of the variants. The total yield in production of certified seeds from Bulgarian potato varieties varies from 2282 to 3556 kg/da. The standard yield of the seed fractions increases significantly with the increase of planting density and decrease of the duration of term of leaf striping.*

**Key words:** potato, production of certified seeds, factors forming the yield, standard yield

## Introduction

Potatoes are basic crop in Bulgaria. During the last years the areas that are occupied by potatoes in Bulgaria were reduced to 15 000 ha with an average yield 1300-1800 kg/da. The inadequate yield level is due to a complex of conditions and reasons like non-

observance of some basic elements in the growing technology of potato for consumption and seed production, disturbed system of variety maintenance and seed production, use of planting material with poor quality, high background of infestation in Bulgaria (Muletarova and Nacheva, 1995), and

low level of material and technical foundation. These reasons result in production of planting material with poor quality and high cost price being a stimulus for import of seed potato. The annual imports of seed potatoes contributes to the emergence of several new diseases and pests – potato cyst nematodes G.

*rostochiensis* (Trifonova and Blagoeva, 2008) and *G. pallida* (Samaliev et al., 1995), new virus strains (Petrov et al., 2008), and pathotypes of pathogens (Nikolov et al., 2008).

The abovementioned circumstances require necessity of development of improved, scientifically valid technological decisions for seed potato production in Bulgaria. Different agrarian and technical decisions are applied for optimization of production systems for certified potato seed like higher planting density (Yang et al., 2009), increased level of mineral fertilization (Callihan et al., 2007), earlier term of leaf striping (Amelyushkina et al., 2008). The application of these decisions result in increase of size of the standard yield in seed fractions, decrease of percentage of non-standard big tubers and have a positive effect on the quality and health status of seed potato (Plotnytska and Vermenko, 2007).

The aim of this study was to investigate yield structure in the production of certified seeds of the Bulgarian potato varieties.

### Material and methods

The experiment was performed in the Maritsa vegetable Crops Research Institute, Plovdiv and in the Experimental station of potato, Samokov, during the period of 2009-2011. Three factors field experiment from 3 x 2 x 2 type i.e. 12 combinations was set for study of the factors having effect on the yield of certified potato seeds. The influence of fertilization rate, planting density and term of leaf striping was established in these combinations.

#### Factor A – Fertilization rate

Degrees  $a_1 - N_{16} P_{14} K_{18}$

$a_2 - N_{18} P_{14} K_{18}$

$a_3 - N_{18} P_{14} K_{22}$

#### Factor B – Planting density

Degrees  $b_1 - 18 \text{ cm}$

$b_2 - 22 \text{ cm}$

#### Factor C – Term of leaf striping

Degrees  $c_1 - 20 \text{ days}$

after mass blossoming

$c_2 - 30 \text{ days}$

after mass blossoming

Field experiment was set in 4 replications at 75 cm distance between the rows on 8 m<sup>2</sup> experimental plot. The seeds were planted on the experimental plots of the Maritsa Vegetable Crops Research Institute, Plovdiv and in Experimental station of potato in Samokov at the beginning of May. The experiments were conducted according to the agricultural practices adopted for potato growing in mountain conditions. The characters recorded during harvesting of the variants from each plot are the following: standard tubers, non-standard tubers, and total tuber number, standard yield, non-standard yield and total yield. According to the Regulation № 16/30.05.2008 the following size of potato seeds were considered: 2,5 to 6 cm – standard potato seeds; 2,5-3,5 cm – small fraction of potato seeds, and 3,5-6 cm – large fraction. Percentage of each fraction and average weight of a tuber were calculated. The obtained data were mathematically processed by Duncan Multiple range test (1955).

### Results and discussions

The significant differences in the yield structure determined by fractions, depending on the influence of fertilizing

rate, planting density and term of leaf striping were recorded in the production of certified potato seeds (Table 1).

The range of values of the total yield in the variety Perun is 2627-3556 kg/da, in the variety Kalina is 2282-3435 kg/da, and in the variety Bor is 2295-3409 kg/da. The variability of this trait depends also on the three factors and their interactions. The maximal value for all Bulgarian varieties is recorded in the variant that combines the increased rate of nitrogen and potassium fertilization, 18 cm distance in the row and where the term of leaf striping was 30 days after mass blossoming. The minimal value was recorded in the variant  $N_{16} P_{14} K_{18}$  where the term of leaf striping was 20 days after mass blossoming, the planting density was 18 cm (Perun and Kalina) and 22 cm (Bor). The total yield increases significantly with the increase of nitrogen and potassium fertilization rate, planting density and the duration of term of leaf striping.

Yield structure determined by fractions in the variety Perun showed that the lowest yield of non-standard tubers with size below 2,5 cm (18 kg/da) was obtained in variant including the increased rate of nitrogen and potassi-



**Table 1.**  
**Structure of yield in the production of certified potato seeds**

Degree	Perun					Kalina					Bor				
	fractions				Total yield (kg/da)	fractions				Total yield (kg/da)	fractions				Total yield (kg/da)
	< 25 mm	25-35 mm	35-60 mm	> 60 mm		< 25 mm	25-35 mm	35-60 mm	> 60 mm		< 25 mm	25-35 mm	35-60 mm	> 60 mm	
<b>a<sub>1</sub> b<sub>1</sub> c<sub>1</sub></b>	70 a	654 ab	1828 ns	75 ns	2627 g	51 ns	509 a	1515 ns	207 b	2282 c	47 a	424 ab	1543 ns	310 ns	2324 i
<b>a<sub>1</sub> b<sub>1</sub> c<sub>2</sub></b>	62 ab	444 a-d	1994 ns	458 ns	2958 d-g	37 ns	425 abc	1783 ns	327 ab	2572 bc	29 abc	390 abc	1763 ns	440 ns	2622 f-i
<b>a<sub>1</sub> b<sub>2</sub> c<sub>1</sub></b>	68 ab	569 abc	1908 ns	260 ns	2805 f-g	37 ns	283 abc	1801 ns	426 ab	2547 bc	29 abc	230 cd	1636 ns	400 ns	2295 i
<b>a<sub>1</sub> b<sub>2</sub> c<sub>2</sub></b>	50 ab	362 cd	2163 ns	365 ns	2940 d-g	27 ns	293 abc	1914 ns	522 ab	2756 abc	18 bc	211 cd	1750 ns	518 ns	2497 g-i
<b>a<sub>2</sub> b<sub>1</sub> c<sub>1</sub></b>	56 ab	696 a	2101 ns	120 ns	2973 c-g	43 ns	430 abc	2028 ns	395 ab	2896 abc	37 ab	360 a-d	1996 ns	457 ns	2850 d-g
<b>a<sub>2</sub> b<sub>1</sub> c<sub>2</sub></b>	28 ab	533 a-d	2366 ns	269 ns	3196 a-e	31 ns	365 abc	2152 ns	586 ab	3134 ab	22 abc	317 a-d	2199 ns	544 ns	3082 a-e
<b>a<sub>2</sub> b<sub>2</sub> c<sub>1</sub></b>	44 ab	440 a-d	2068 ns	291 ns	2843 e-g	24 ns	370 abc	1970 ns	585 ab	2949 abc	15 bc	240 cd	2115 ns	443 ns	2813 e-h
<b>a<sub>2</sub> b<sub>2</sub> c<sub>2</sub></b>	39 ab	281 d	2355 ns	494 ns	3169 b-f	25 ns	225 bc	2098 ns	757 a	3105 ab	9 c	194 d	2192 ns	556 ns	2951 b-f
<b>a<sub>3</sub> b<sub>1</sub> c<sub>1</sub></b>	53 ab	560 abc	2351 ns	333 ns	3297 a-d	35 ns	447 ab	2148 ns	485 ab	3115 ab	29 abc	449 a	2339 ns	449 ns	3266 abc
<b>a<sub>3</sub> b<sub>1</sub> c<sub>2</sub></b>	41 ab	322 cd	2800 ns	393 ns	3556 a	25 ns	307 abc	2470 ns	633 ab	3435 a	19 bc	264 bcd	2573 ns	553 ns	3409 a
<b>a<sub>3</sub> b<sub>2</sub> c<sub>1</sub></b>	29 ab	468 a-d	2263 ns	402 ns	3162 b-f	30 ns	230 bc	2214 ns	609 ab	3083 ab	18 bc	249 bcd	2271 ns	702 ns	3240 a-d
<b>a<sub>3</sub> b<sub>2</sub> c<sub>2</sub></b>	18 b	292 d	2508 ns	563 ns	3381 ab	18 ns	215 c	2262 ns	793 a	3288 ab	9 c	207 cd	2364 ns	819 ns	3399 a
<b>a<sub>1</sub> (average)</b>	63 ab	507 a-d	1973 ns	290 ns	2833 e-g	38 ns	377 abc	1753 ns	371 ab	2539 bc	31 abc	314 a-d	1673 ns	417 ns	2435 h-i
<b>a<sub>2</sub> (average)</b>	42 ab	488 a-d	2223 ns	293 ns	3046 b-f	31 ns	347 abc	2062 ns	581 ab	3021 abc	21 abc	278 a-d	2126 ns	500 ns	2925 b-f
<b>a<sub>3</sub> (average)</b>	35 ab	411 b-d	2481 ns	423 ns	3349 a-c	27 ns	300 abc	2274 ns	630 ab	3231 ab	18 bc	292 a-d	2387 ns	631 ns	3328 ab
<b>b<sub>1</sub> (average)</b>	52 ab	535 a-d	2240 ns	275 ns	3101 b-f	37 ns	414 abc	2016 ns	439 ab	2906 abc	30 abc	367 a-d	2069 ns	459 ns	2925 b-f
<b>b<sub>2</sub> (average)</b>	41 ab	402 b-d	2211 ns	396 ns	3050 b-f	27 ns	269 bc	2043 ns	615 ab	2954 abc	16 bc	222 cd	2054 ns	573 ns	2865 c-g
<b>c<sub>1</sub> (average)</b>	53 ab	565 abc	2087 ns	247 ns	2951 d-g	37 ns	378 abc	1946 ns	451 ab	2812 abc	29 abc	325 a-d	1983 ns	460 ns	2797 e-h
<b>c<sub>2</sub> (average)</b>	40 ab	372 cd	2364 ns	424 ns	3200 a-e	27 ns	305 abc	2113 ns	603 ab	3048 ab	18 bc	264 bcd	2140 ns	572 ns	2994 b-f
<b>Mean value</b>	<b>47</b>	<b>468</b>	<b>2225</b>	<b>335</b>	<b>3076</b>	<b>32</b>	<b>341</b>	<b>2030</b>	<b>527</b>	<b>2930</b>	<b>23</b>	<b>295</b>	<b>2062</b>	<b>516</b>	<b>2896</b>



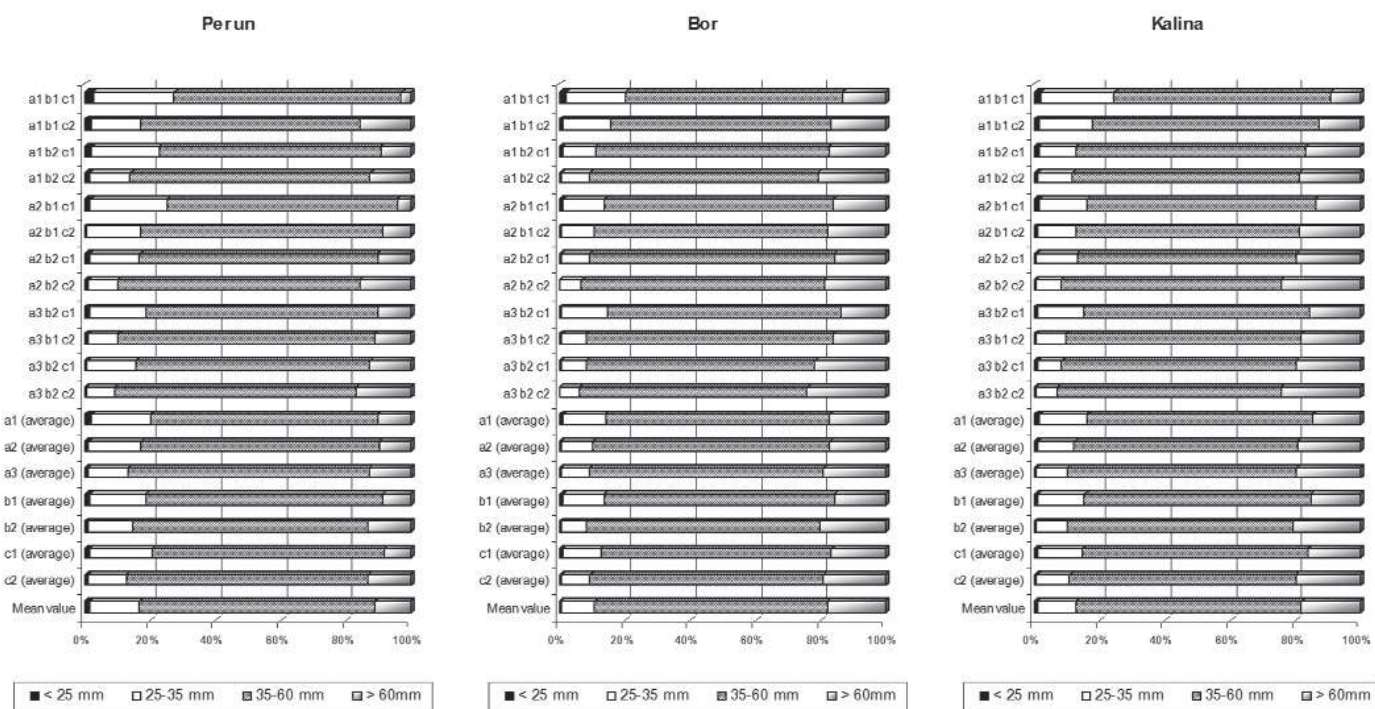


Figure 1. Percentage of yield distribution fractions obtained from varieties Perun, Kalina and Bor

um fertilization, 22 cm planting density and term of leaf striping 30 days after mass blossoming. The highest yield (70 kg/da) was recorded in the variant of fertilization  $N_{16} P_{14} K_{18}$ , 18 cm planting density and term of leaf striping 20 day after

mass blossoming. The minimum and the maximum values of non standard yield in fraction less than 2,5 cm in the varieties Kalina and Bor were recorded in the same two combinations, but the amplitude of variation is lower (18-51 kg/da in Kalina

and 9-47 kg/da in Bor). The amount of this non-standard fraction decreases with increase of the fertilization rate with nitrogen and potassium, distance in the row and duration of leaf striping. The percentage expression of the fraction as a part of





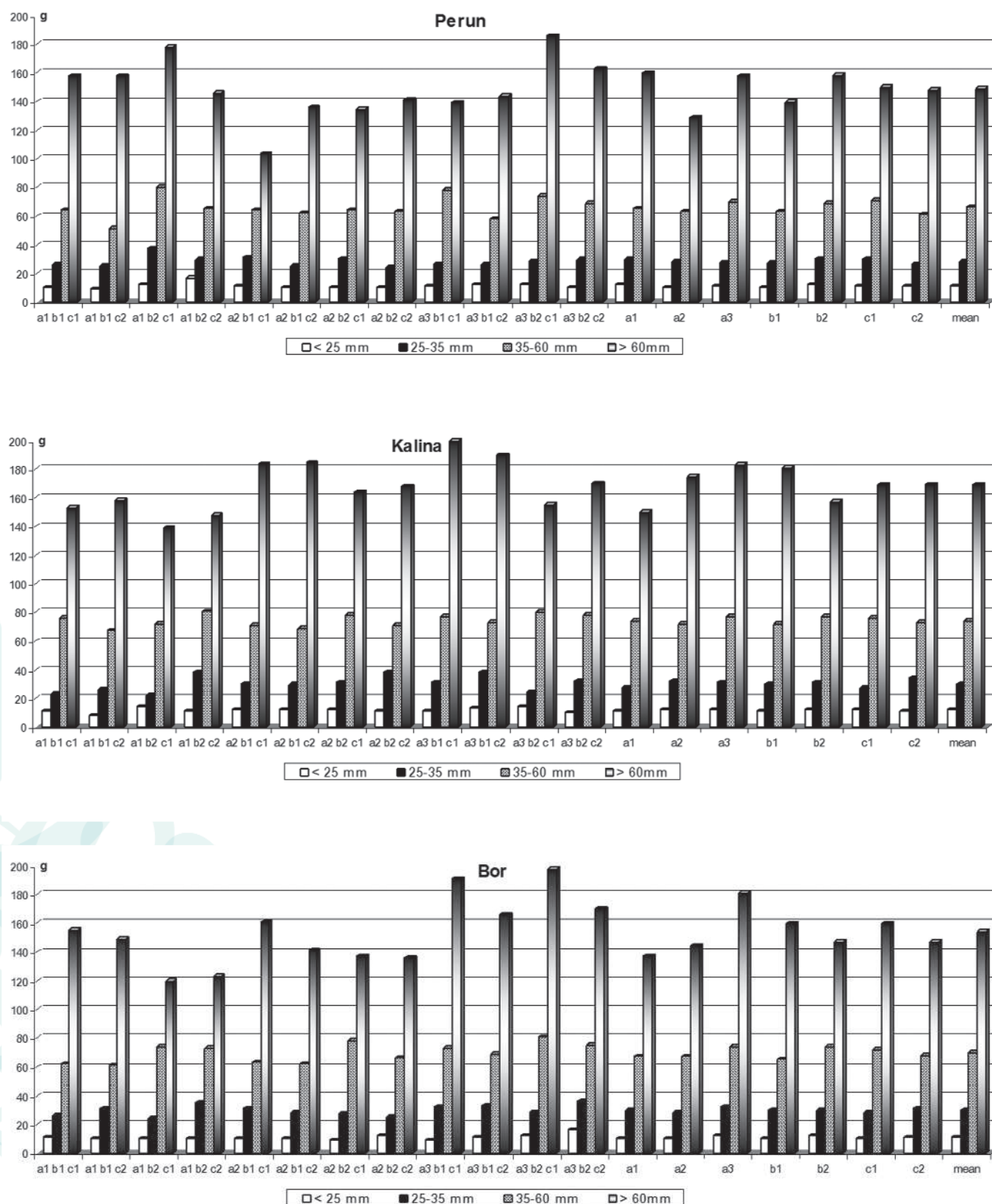


Figure 1. Percentage of yield distribution fractions obtained from varieties Perun, Kalina and Bor

total yield per variety is comparatively small (Figure 1) and varies from 0,5 to 2,7 % in Perun, 0,5-2,2 % in Kalina and 0,3-2,0 % in Bor. The average weight of tubers in this fraction is 9-17 g (Figure 2).

The yield of small seed fraction (25-35 mm) varies from 194 kg/da (Bor, variant  $N_{18} P_{14} K_{18}$ , 22 cm planting density and term of leaf striping 30 day after mass blossoming) to 696 kg/da (Perun,

in variant including the increased rate of nitrogen fertilization, 18 cm planting density and term of leaf striping 20 days after mass blossoming). Its average absolute value is 468 kg/da for the vari-

ety Perun and in percentage – 15,2 % with an average weight of tubers 28 g, 341 kg/da for the variety Kalina and in percentage – 11,6 % with an average weight of tubers 30 g, and 295 kg/da for the variety Bor and in percentage – 10,2 % with an average weight of tubers 30 g. The maximal expression of this fraction is recorded in the variants including 18 cm planting density and term of leaf striping 20 days after blossoming. The amount of the fraction (25-35 mm) decreases with increase of nitrogen fertilization rate, of distance in the row and of duration of term for leaf striping. The percentage expression of the fraction as a part of total yield for each variant is with amplitude of variation from 6,1 to 24,9 %, and an average weight of tubers from 22 to 38 g.

The fraction 35-60 mm is described as having the highest percentage of the total yield – average 72,4 % and in absolute value – 2225 kg/da for the variety Perun, 69,3 % and in absolute value – 2030 kg/da for the variety Kalina, and 71,2 % and in absolute value – 2062 kg/da for the variety Bor. The yield in the large seed fraction varies from 1515 kg/da (Kalina, in the variant  $N_{16} P_{14} K_{18}$ , term of leaf striping 20 days after mass blossoming and 18 cm planting density)

to 2800 kg/da (Perun, in the variant  $N_{18} P_{14} K_{22}$ , term of leaf striping 30 days after mass blossoming and 18 cm planting density), and the average weight of tubers varies from 51 to 81 g. The maximal value for all Bulgarian varieties was recorded in the variant with the increased rate of nitrogen and potassium fertilization, 18 cm planting density and term of leaf striping 30 day after mass blossoming. The seed amount from this fraction increases with the increase of N and K fertilization rate and duration of leaf striping term. Its percentage is with amplitude from 66,4 to 78,7 %.

The yield of the non-standard fraction of the large tubers with 6 cm diameter in different combinations varies from 75 to 819 kg/da, its percentage – from 2,9 to 24,4 %, and the average tuber weight varies from 104 to 217 g. The higher dose of nitrogen and potassium fertilization, the larger distance of planting and the more late term of leaf striping have an unfavorable effect, for example they increase the proportion of non-standard large tuber.

### Conclusions

The significant differences in the yield structure determined by fractions, depending on the influence of fertilizing

rate, planting density and term of leaf striping were recorded in the production of certified potato seeds.

The total yield of certified seeds of the Bulgarian potato varieties Perun, Kalina and Bor varies from 2282 to 3556 kg/da. The total yield increases significantly with the increase of nitrogen and potassium fertilization rate, planting density and the duration of term of leaf striping.

The percentage of the non-standard tubers with size below 2,5 cm is the lowest (in average 1,1 %) among the total produce.

The percentage of the fraction of the small seeds with diameter from 2,5 to 3,5 cm is within the limits 6,1 to 24,9 %. The maximal expression of this fraction is recorded in the variants including 18 cm planting density and term of leaf striping 20 days after blossoming.

The amount of the fraction of large seeds with size from 3,5 to 6 cm varies from 66,4 to 78,7%.

The yield of the non-standard large tubers with diameter over 6 cm is averagely 460 kg/da, that is 15,6 % from the total produce. The more dense planting and earlier term of leaf striping can positively influence on reduction of this fraction.

### References

1. Amelyushkina T., Semeshkina P., Anisimov B., 2008. The effect of leaf stripping and protective measure data on potato seed material. Potato culture: research results, innovations, practice. Materials of scientific and practical conference Scientific Supply and Innovative Development of Potato Culture (v.1), p. 369-376.
2. Callihan R., R. Mc Dole, P. Mann, 2007. The influence of nitrogen and phosphorus fertilization on periderm anatomy in Russet Burbank potatoes. American Journal of Potato Research, Volume 50, Number 10, 380-387,
3. Duncan, D., 1955. Multiple range and multiple F tests. Biometrics. 11:1-42
4. Muletarova, S., E. Nacheva, 1995. Monitoring of the viral diseases on potatoes of the main seed productive regions. Higher Institute of Agriculture-Plovdiv, Scientific Works, v.III, book 2, 15-18.
5. Nikolov P., Laginova M., Dimitrova L. 2008. The potato wart disease in Bulgaria – symptoms, spreading and response of the varieties Plant Science (Bulgaria) v. 45(1) p. 28-31.
6. Petrov N., D. Khristova, C. Heinze, P. Willingman, G. Adam, 2008. Identification of the Virus, Causing Necrotic Ring Spots on Potato Tubers in Bulgaria. Plant Science (Bulgaria) v. 45(5) p. 407-411.
7. Plotnytska, O.V., Vermenko, Yu, 2007. Productivity of seed potato depending on phytosanitary growing conditions. Ahrarna Nauka, issue 36, p. 74-78.
8. Samaliev H., O. Baicheva, A. Aleksiev, 1995. Identification of potato cyst nematode /Globodera pallida/ in Bulgaria. Higher Institute of Agriculture-Plovdiv, Scientific Works, v.XI, book 3, p. 251-255.
9. Trifonova Z., V. Blagoeva, 2008. Resistance of lines and potato cultivars to Globodera rostochiensis. Plant Science (Bulgaria) v. 45(3) p. 218-221.
10. Yang X, H Tian, J Wei, 2009. Effect of different sowing method and population density on seed potato production. Southwest China Journal of Agricultural Sciences, p. 4-9.