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06

Ribarstvo, lovstvo i pčelarstvo

Fisheries, Game Management and Beekeeping

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08

Voćarstvo, vinogradarstvo i vinarstvo Pomology, Viticulture and Enology

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ORIGINAL SCIENTIFIC PAPER

Plant development, seed yield and oil content of winter oilseed rape (*Brassica napus* L.) as affected by time of sowing and genotype

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Abstract

This paper presents characterization of some components of seed yield, yield and rapeseed oil in order to compare 10 winter genotypes with aim to chosen some of them with best characteristics for Skopje region in Macedonia. The experiment was conducted during 2010/2011 and 2011/2012 seasons. Eight winter oilseed rape hybrids *Hybrirock*, *Triangle*, *Petrol*, *Speed*, *Artoga*, *Albatros*, *Rohan* and *AbaKus*, and two varieties *Banacanka* and *Majdan*, were tested under three seeding dates 15 September, 25 September and 5 October. The results showed that all genotypes achieved in the first seeding date the significant heights plants, the most number of branches on plant and number of seeds in pod, the largest weight on 1000 seeds, the largest seed yield and oil content in seed. Only length of pods was unchanged under seeding date affect and without significant differences between, but in terms of genotypes differences, the variety *Banacanka*, reached the significant longest pods. Duration of vegetation was not affected from seeding date, but between genotypes showed significant differences. *Artoga*, *Albatros*, *Rohan* and *AbaKus* achieved significant the shortest duration of vegetation. The biggest value of oil content achieved two hybrids: *Artoga* and *Speed* with 49.9% and 49.8%.

Keywords: components of seed yield, seed yield, oil content, hybrids, varieties

Introduction

Oilseed rape or Canola (*Brassica napus* L.), became one of the most important oil plant in the world. In Macedonia attempts to introduces as oil culture which will be replaced sunflower which has been the most important oil plant in the near past. His oil has big quality for human diet and for biofuel, and meal it very good for animal feed. Oil and meal are now very acceptable as alternatives to soybeans oil and meal (Amin and Khalil, 2005; Muhammad, et al., 2007).

Materials and methods

Field studies were conducted in village Gluvo near Skopje in Macedonia during 2010 /2011 and 2011/2012 seasons. The meteorological data of the experimental locations during rapeseed growing seasons are shown in Table 1. Ten genotypes: eight hybrids *Hybrirock*, *Triangle*, *Petrol*, *Speed*, *Artoga*, *Albatros*, *Rohan* and *AbaKus* and two varieties *Banacanka* and *Majdan* were used in this study. The trials were set up in a complete randomized block design (RCBD) with three replications. The experimental fields were mould-board ploughed on 25 cm depth and seedbed preparation consisted of surface treatment with harrow. Seed were hand planted on three dates 15 September, 25 September and 5 October in 2010 and 2011, respectively. Plots were 10m² with 10 rows in each and space on 20 cm between. Used seeding rate was 7 kg ha⁻¹. Before sowing was perform the basic fertilization with NPK (8:22:20) with rate of 500 kg ha⁻¹. After wintering was applying nitrogen fertilizer KAN (27% N) in stage Bolting (first, when Flower cluster was visible at center of rosette, and

second, when Flower cluster raised above level of rosette) with rate of 120 kg ha⁻¹. In growth stage Flowering, was used several times insecticide against *Meligethesaeneus*. Weed control was combined with hand weeding and uses of herbicides. All growth stages were followed and were conducted measurements on field (height of plants, number of branches) and in laboratory (length of pods, number of seeds in pod, 1000 seed weight, seed yield and oil content in seed). Data were subjected to analysis of variance (ANOVA) for each year using SAS and SPSS software.

Results and discussion

Plant development. All genotypes enter in growing stages timely in both years although they lasting different numbers of days (Table 2). This situation can explained with different meteorological conditions during investigated two growing season (Table 1).

Plant height. The highest plants achieved hybrid Petrol in first seeding date 118.47 cm in first growing year, the shortest variety Majdan 42.00 cm in third seeding date in first growing year.

Table 1. Meteorological date of Skopje region, during oilseed rape growing season

| Month/ Year | IX | X | XI | XII | I | II | III | IV | V | VI | VII |
|--------------------------|-----------------------|-------|------|------|------|------|------|------|-------|------|------|
| | Mean temperature (°C) | | | | | | | | | | |
| 2010/11 | 19.0 | 11.1 | 11.2 | 2.7 | 1.0 | 2.7 | 8.1 | 12.9 | 16.7 | 21.7 | 24.4 |
| 2011/12 | 22.7 | 11.7 | 5.0 | 2.7 | 0.0 | -1.4 | 9.3 | 13.3 | 16.9 | 24.2 | 27.7 |
| Total precipitation (mm) | | | | | | | | | | | |
| 2010/11 | 37.3 | 143.9 | 81.0 | 64.8 | 23.1 | 19.4 | 19.0 | 16.9 | 42.0 | 18.3 | 34.3 |
| 2011/12 | 88.2 | 27.0 | 2.3 | 23.6 | 30.9 | 43.9 | 16.0 | 10.4 | 111.4 | 11.7 | 10.0 |

Table 2. Duration of stages of development

| Growth stages Year | Seeding date treatment | Seedling (Cotyledons showing) | Leaf rosette | Winter stand | Bud (Bolting) | Flowering | Ripening |
|-----------------------|------------------------------|-------------------------------------|-----------------|-----------------|------------------|-----------|----------|
| 2010/2011 | I | 7-9 | 73-75 | 99 | 28-40 | 23-29 | 35-50 |
| | II | 7 | 66 | 99 | 35-36 | 32-33 | 29-46 |
| | III | 17 | 45 | 116 | 25 | 25-27 | 31-49 |
| 2011/2012 | I | 13 | 76 | 112 | 14-18 | 19-23 | 38-41 |
| | II | 10 | 68 | 113 | 19 | 20-26 | 37-40 |
| | III | 9 | 59 | 120 | 19 | 21-30 | 47-49 |

Table 3. Average of duration of vegetation per genotypes

| Seeding date (B) | Genotype (A) | | | | | | | | | | |
|------------------------|--------------|----------|--------|--------|--------|----------|-------|--------|-----------|--------|-------------|
| | Hybrirock | Triangle | Petrol | Speed | Artoga | Albatros | Rohan | AbaKus | Banačanka | Majdan | \bar{x} B |
| I | 284.5 | 284.5 | 284.5 | 284.5 | 284.5 | 284.5 | 277 | 277 | 278.5 | 286.5 | 282.6 |
| II | 281 | 281 | 281 | 281 | 273 | 273 | 273 | 273 | 282.5 | 283 | 278.2 |
| III | 278 | 278 | 278 | 278 | 278 | 278 | 268 | 268 | 281.5 | 281.5 | 276.7 |
| \bar{x} A | 281.2* | 281.2* | 281.2* | 281.2* | 277.7 | 277.7 | 272.7 | 272.7 | 280.8 | 283.7* | 279.2 |

LSD (A) = 3.83 LSD (B) = 10.99

Table 4. Genotypes mean for yield components and seed yield

| Genotype | Year | Seeding date treatment | Height of plants (cm) | Number of branches | Pods length (cm) | Number of seeds in pod | 1000 seed weight (g) | Seed yield (kg/ha) |
|-----------|-----------|------------------------|-----------------------|--------------------|------------------|------------------------|----------------------|--------------------|
| Hybrirock | 2010/2011 | I | 109.70 | 7.2 | 6.25 | 23.63 | 4.34 | 4032.00* |
| | | II | 90.33 | 4.07 | 6.82 | 25.77 | 3.99 | 2930.00 |
| | | III | 54.10 | 2.53 | 7.21 | 21.47 | 4.10 | 1228.67 |
| | 2011/2012 | I | 105.13 | 3.53 | 7.43 | 24.47 | 4.30 | 2435.00 |
| | | II | 99.53 | 2.93 | 8.27 | 25.33 | 4.04 | 2084.67 |
| | | III | 109.60 | 3.6 | 6.50 | 25.33 | 3.98 | 2673.67 |
| Triangle | 2010/2011 | I | 115.70 | 6.4 | 7.12 | 23.47 | 4.66 | 2937.33 |
| | | II | 82.00 | 3.47 | 6.88 | 22.30 | 4.18 | 1505.00 |
| | | III | 50.70 | 1.67 | 7.60 | 20.50 | 4.51 | 502.67 |
| | 2011/2012 | I | 98.20 | 2.87 | 8.03 | 23.07 | 4.72* | 1934.67 |
| | | II | 90.07 | 2.53 | 7.03 | 25.33 | 4.36 | 1555.67 |
| | | III | 101.13 | 2.93 | 7.33 | 21.93 | 4.26 | 2100.67 |
| Petrol | 2010/2011 | I | 118.47* | 6.47 | 7.20 | 24.47 | 4.15 | 3414.67 |
| | | II | 91.13 | 3.67 | 7.11 | 25.20 | 3.93 | 1605.00 |
| | | III | 57.77 | 1.93 | 7.12 | 21.43 | 4.02 | 364.67 |
| | 2011/2012 | I | 107.80 | 3.13 | 8.63 | 24.80 | 4.01 | 1908.33 |
| | | II | 109.20 | 3.53 | 7.70 | 24.33 | 3.48 | 1821.67 |
| | | III | 104.20 | 3.4 | 7.47 | 23.93 | 3.43 | 2178.67 |
| Speed | 2010/2011 | I | 115.10 | 5.8 | 7.02 | 25.07 | 4.45* | 3858.33 |
| | | II | 92.53 | 3.6 | 7.51 | 27.13 | 3.98 | 2371.33 |
| | | III | 63.53 | 2 | 7.54 | 24.43 | 4.06 | 916.67 |
| | 2011/2012 | I | 105.33 | 2.27 | 8.20 | 27.20 | 4.01 | 2391.00 |
| | | II | 111.13 | 3 | 8.03 | 27.33* | 3.48 | 2133.67 |
| | | III | 101.60 | 3.27 | 7.63 | 26.60 | 3.43 | 2823.33 |
| Artoga | 2010/2011 | I | 113.33 | 8.33* | 6.88 | 25.37 | 4.14 | 2997.67 |
| | | II | 93.37 | 3.93 | 6.50 | 25.32 | 3.71 | 2371.33 |
| | | III | 57.47 | 1.8 | 6.95 | 24.70 | 3.86 | 763.33 |
| | 2011/2012 | I | 101.47 | 2.87 | 6.83 | 24.87 | 4.38 | 2246.33 |
| | | II | 100.00 | 3 | 7.40 | 25.87 | 4.43 | 1994.00 |
| | | III | 99.87 | 3.13 | 6.57 | 23.20 | 4.41 | 2781.00 |
| Albatros | 2010/2011 | I | 112.77 | 6.93 | 7.08 | 26.10 | 4.52 | 2710.67 |
| | | II | 82.27 | 4.67 | 7.21 | 28.07* | 4.19 | 1691.00 |
| | | III | 55.23 | 1.93 | 7.04 | 23.70 | 4.41 | 757.00 |
| | 2011/2012 | I | 98.20 | 3.53 | 6.77 | 24.93 | 4.73* | 2125.67 |
| | | II | 107.27 | 3.73 | 6.43 | 26.27 | 4.33 | 2073.00 |
| | | III | 111.20 | 3.87 | 7.07 | 24.20 | 4.46 | 2709.00 |
| Rohan | 2010/2011 | I | 121.47 | 9.2* | 7.45 | 25.17 | 4.22 | 3274.67 |
| | | II | 94.07 | 6 | 6.62 | 23.17 | 4.11 | 2873.00 |
| | | III | 58.77 | 2.4 | 7.41 | 21.97 | 4.41 | 840.33 |
| | 2011/2012 | I | 97.27 | 4.2 | 8.53 | 24.73 | 4.34 | 2258.00 |
| | | II | 93.00 | 3.07 | 7.30 | 24.73 | 4.53* | 2299.33 |
| | | III | 99.40 | 2.73 | 7.83 | 23.27 | 4.46 | 2725.67 |
| AbaKus | 2010/2011 | I | 114.90 | 8.73* | 7.73 | 24.30 | 4.10 | 3456.67 |
| | | II | 87.90 | 3.73 | 7.32 | 26.57 | 3.80 | 1500.67 |
| | | III | 59.90 | 1.6 | 8.14 | 23.03 | 3.79 | 768.67 |
| | 2011/2012 | I | 100.20 | 4.2 | 8.53 | 25.13 | 4.13 | 1864.33 |
| | | II | 98.47 | 3.87 | 7.43 | 25.60 | 4.03 | 2520.67 |
| | | III | 104.20 | 2.93 | 7.83 | 23.47 | 3.83 | 2927.00 |
| Banacanka | 2010/2011 | I | 117.00 | 7.33 | 7.23 | 24.40 | 4.30 | 3234.67 |
| | | II | 86.10 | 4.07 | 7.52 | 24.67 | 4.03 | 1993.67 |
| | | III | 52.37 | 1.33 | 7.42 | 19.20 | 4.22 | 374.33 |
| | 2011/2012 | I | 97.60 | 2.07 | 7.50 | 23.60 | 4.17 | 1470.33 |
| | | II | 109.47 | 2.6 | 9.00* | 25.00 | 3.81 | 1682.67 |
| | | III | 113.60 | 3.73 | 8.83 | 23.60 | 3.38 | 1459.33 |
| Majdan | 2010/2011 | I | 112.30 | 5.6 | 6.36 | 21.43 | 3.61 | 2164.00 |
| | | II | 93.30 | 3.73 | 7.00 | 22.57 | 3.49 | 1019.33 |
| | | III | 42.00 | 1.07 | 6.41 | 18.73 | 3.51 | 211.00 |
| | 2011/2012 | I | 100.77 | 2.6 | 7.33 | 22.73 | 4.28 | 1408.67 |
| | | II | 102.47 | 3.33 | 7.23 | 23.13 | 3.78 | 864.00 |
| | | III | 106.01 | 3.8 | 6.90 | 24.40 | 3.71 | 558.67 |

Table 5. Mean values of two years research of yield components, seed yield and oil content

| Genotype | Seeding date treatment | Height of plants (cm) | Number of branches | Pods length (cm) | Number of seeds in pod | 1000 seed weight (g) | Seed yield (kg/ha) | Oil content (%) |
|-----------|------------------------|-----------------------|--------------------|------------------|------------------------|----------------------|--------------------|-----------------|
| Hybrirock | I | 107.42 | 5.37 | 6.84 | 24.05 | 4.32 | 3233.5 | 46.2 |
| | II | 94.93 | 3.50 | 7.55 | 25.55 | 4.02 | 2507.3 | 43.5 |
| | III | 81.85 | 3.07 | 6.86 | 23.40 | 4.04 | 1951.2 | 39.2 |
| Triangle | I | 106.95 | 4.64 | 7.58 | 23.27 | 4.69 | 2436.0 | 42.1 |
| | II | 86.04 | 3.00 | 6.96 | 23.82 | 4.27 | 1530.3 | 39.8 |
| | III | 75.92 | 2.30 | 7.47 | 21.22 | 4.39 | 1301.7 | 37.3 |
| Petrol | I | 113.14 | 4.80 | 7.92 | 24.64 | 4.08 | 2661.5 | 48.6 |
| | II | 100.17 | 3.60 | 7.41 | 24.77 | 3.71 | 1713.3 | 43.6 |
| | III | 80.99 | 2.67 | 7.30 | 22.68 | 3.73 | 1271.7 | 39.9 |
| Speed | I | 110.22 | 4.04 | 7.61 | 26.14 | 4.23 | 3124.7 | 49.8* |
| | II | 101.83 | 3.30 | 7.77 | 27.23 | 3.73 | 2252.5 | 42.7 |
| | III | 82.57 | 2.64 | 7.59 | 25.52 | 3.75 | 1870.0 | 41.9 |
| Artoga | I | 107.40 | 5.60 | 6.86 | 25.12 | 4.26 | 2622.0 | 49.9* |
| | II | 96.69 | 3.47 | 6.95 | 25.60 | 4.07 | 2182.7 | 42.4 |
| | III | 78.67 | 2.47 | 6.76 | 23.95 | 4.14 | 1772.2 | 40.7 |
| Albatros | I | 105.49 | 5.23 | 6.93 | 25.52 | 4.63 | 2418.2 | 48.1 |
| | II | 94.77 | 4.20 | 6.82 | 27.17 | 4.26 | 1882.0 | 44.3 |
| | III | 83.22 | 2.90 | 7.06 | 23.95 | 4.44 | 1733.0 | 42.3 |
| Rohan | I | 109.37 | 6.70 | 7.99 | 24.95 | 4.28 | 2766.3 | 49.4 |
| | II | 93.54 | 4.54 | 6.96 | 23.95 | 4.32 | 2586.2 | 40.2 |
| | III | 79.09 | 2.57 | 7.62 | 22.62 | 4.44 | 1783.0 | 39.7 |
| AbaKus | I | 107.55 | 6.47 | 8.13 | 24.72 | 4.12 | 2660.5 | 46.7 |
| | II | 93.19 | 3.80 | 7.38 | 26.09 | 3.92 | 2010.7 | 43.3 |
| | III | 82.05 | 2.27 | 7.99 | 23.25 | 3.81 | 1847.8 | 41.8 |
| Banacanka | I | 107.30 | 4.70 | 7.37 | 24.00 | 4.24 | 2352.5 | 42.9 |
| | II | 97.79 | 3.34 | 8.26 | 24.84 | 3.92 | 1838.2 | 39.1 |
| | III | 82.99 | 2.53 | 8.13 | 21.40 | 3.80 | 916.8 | 38.8 |
| Majdan | I | 104.39 | 4.10 | 6.85 | 22.08 | 3.95 | 1786.3 | 44.7 |
| | II | 99.95 | 3.53 | 7.12 | 22.85 | 3.64 | 941.7 | 41.3 |
| | III | 78.67 | 2.44 | 6.66 | 21.57 | 3.61 | 384.8 | 37.7 |

Table 6. Average results for seed yield and oil content

| Date of seeding | Height of plants (cm) | Number of brunches on plant | Length of pods (cm) | Number of seeds in pod | 1000 seeds weight (g) | Yield of seed (kg/ha) | Oil content in seed (%) |
|-----------------|-----------------------|-----------------------------|---------------------|------------------------|-----------------------|-----------------------|-------------------------|
| I | 108.4* | 5.2* | 7.4 | 24.5* | 4.3* | 2606.2* | 46.84* |
| II | 95.9* | 3.6* | 7.3 | 25.0* | 4.0 | 1944.5 | 42.02 |
| III | 80.6 | 2.6 | 7.3 | 23.0 | 4.0 | 1483.2 | 39.93 |
| LSD (0,05) | 5.16 | 0.6 | 0.44 | 1.4 | 0.22 | 558.22 | 3.50 |

Number of branches. Hybrid Rohan showed the best results of 9.2 branches in first seeding date and first growing year, and variety Majdan the worst of 1.07 branches in the third seeding date and first growing year.

Pods length. This characterization showed no significant differences between seeding dates, but genotypes showed. Variety Banacanka achieved 9.00 cm long pod in second seeding date, and shortest pods has variety Majdan with 6.41 cm in third seeding date in first growing year.

Number of seeds in pod. Hybrid Albatros reached 28.07 seeds in pod in second seeding date in first growing year, and variety Majdan 18.73 seeds in pod has the lowest results in third seeding date in first growing year.

1000 seed weight. Hybrids Albatros and Triangle reached 4.73 g and 4.72 g of 1000 seeds weight in first seeding date, but in second growing year. The smaller seed weight from 3.38 g has variety Banacanka in third seeding date second growing year.

Seed yield. Hybrid Hybrirock reached the best results from 4032 kg ha⁻¹ in first seeding date and first growing year. Variety Majdan has the smallest results for seed yield from 211.00 kg ha⁻¹ in third seeding date in first growing year.

Oil content. The average results for oil content in seed showed that hybrid Artoga reached the best results from 49.9% oil in seed, and the lower content from 37.3% reached hybrid Triangle in third seeding date.

Conclusions

From the obtain results can conclude that first seeding date 15.09 is good for seeding oilseed rape in Skopje region. From investigated genotypes Hybrirock reached the best results for seed yield average 3233,5kg/ha, and hybrid Artoga reached the best results for oil content with average 49,9% oil in seed.

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