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INFLUENCE OF ROW SPACING AND BIOREGULATORS APPLICATION ON SAFFLOWER YEILD

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Abstract

Safflower (Carthamus tinctorius) is one of the new crops for the Republic of Moldova. Its traditional climate conditions of cultivation are significantly different from those in Moldova. The research of optimal agronomic procedures related to the eco-geographical area is the main objective for introduction of this new culture. The aim of this study was to determine the safflower yield depending on distance between rows and pre-sowing treatment of seeds with natural bioregulators. Row spacing was 50 and 70 cm, as natural bioregulators were used glycosides compositions extracted from Linaria genistifolia (GG) and Verbascum densiflorum (*GV). The results showed that row spacing effect was significant on plants height, number of capitula per plant, number of seeds per plant and 100-seed weight. Enlarging of row spacing leads to increasing of branch number and seeds yield per plant. Number of seeds per plant of safflower grown on 70 cm row spacing was in 1.4…1.7 times more than the same parameter of plants grown on row distance of 50 cm. The increasing of row spacing increased seed yield per plant in all experimental variants: safflower grown from both treated and intact seeds. The highest number of capitula per plant and 100-seeds weight in both row spacing was obtained from safflower seeds treated by GV - natural bioregulator, composition of which contains the polyphenolic glycoside.*

Key words*: safflower, yield, row spacing, bioregulators.*

INTRODUCTION

As safflower (*Carthamus tinctorius*) is a new crop for the Republic of Moldova, its agronomic requirements for meteorological condition of the country have not been studied sufficiently yet. In our previous study (Ivanova, 2016), it was shown that the safflower plants have adapted to the drought conditions of 2015 season: temperature was 2.2…3.3ºC higher and amount of precipitation - lower by 100…200 mm than the long-term average. These properties were confirmed by the biological characteristics and seeds yield. However, vital yield attributes of safflower crop such as number of capitula and seeds per plant, 100-seeds weight depend not only on meteorological condition of growing season. The different agronomic procedures (planting pattern, application of bioregulators or fertilizer) also have the important influence on safflower crop.

Results of many studies showed that the sowing spacing between rows and plants in row had significant impact on plants growth and yield of safflower (Azari & Khajehpour, 2003; Fazeli et al., 2007; Pasary and Noormohamadi, 2011; Ruzheynikova et al., 2012; Mohammadi and Karimizadeh, 2013; Vaghar et al., 2014; Hamza, 2015).

Row spacing of safflower was diversified in large diapason from 15 cm to 90 cm, but demonstrated results are controversial. Amoghin et al. (2012) concluded that as plant density was decreased, the number of capitula per plant, 100-seed weight, and the number of seeds per plant were increased, but the number of seeds per capitula and yield per unit area were significantly decreased. In contrast, Mohammadi and Karimizadeh (2013) determined the highest number of seeds per capitula of safflower on larger row spacing. Pasary and Noormohamadi (2011) provided that the highest plant height related to lowest density, but the results reported by Hamza (2015) were opposite.

The research and testing of varying planting patterns of safflower indicated that its effectiveness has been also predetermined by the soil and climatic conditions, humidity and

soil contamination, sowing date, growth regulators application, economic purpose, and high-quality features of genotypes (Ruzheynikova et al., 2012; Sharifi et al., 2012; Vaghar et al., 2014). Therefore, the differentiated approach should be applied for determination of optimal agronomic procedures connected with eco-geographical area.

The aim of this study was to determine yield parameters of safflower grown on different row spacing from intact seeds and seeds gone through pre-sowing treatment with bioregulators.

MATERIALS AND METHODS

Experiments were carried out at the research field station of the Institute of Genetics, Physiology and Plant Protection in Chisinau area of the Republic of Moldova (lat. 47°01', long. 28°75', alt. 85 m above sea level), in the seasons of 2016 (Figure 1).

Figure 1. Field station of the Institute of Genetics, Physiology and Plant Protection

Safflower seeds have been sowed in the last decade of March by using following planting patterns: row spacing 50 cm and 70 cm, intra-row spacing 15 cm. Moreover, part of seeds was subjected to presowing treatment by 0.01% solutions of two natural bioregulators - glycosides compositions extracted from *Linaria genistifolia* (GG), and *Verbascum densiflorum* (GV). The dry extracts GG and GV were obtained in laboratory conditions and already tested as regulators of plant growth and antioxidant (Ivanova et al., 2014; Mascenco et al., 2015a, 2015b; Borovskaia et al., 2016). Thus, each area of cultivations consisted of three plants variants (two treated – GV, GG; and control - intact seeds) in 5 repetitions. Plants were grown in poor and dry soil, without irrigation.

Weather in the spring and summer of 2016 was characterized as warm and rainy. During the growing season the average of air temperature in spring (March - May) was +10.9...+12.2°C, in the summer (June - August) was +20.8...+ 23.0ºC, being above the long-term average by 1.8...2.7°C and 1.5...2.4ºC, correspondingly. The amount of spring and summer precipitation has reached 148-216 mm (125-180% of the long-term average) and 275-330 mm (140-150% of the long-term average), respectively.

In order to evaluate the impact of planting patterns and application of bioregulators the following parameters of safflower plants were studied: plant height (cm), number of secondary branches per plant, number of capitula (Figure 2) and seeds per plant (Figure 3), seeds yield per plant (g), 100-seeds weight (g).

Figure 2. Flower and capitula of safflower plant

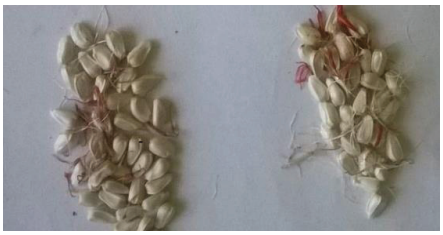

Figure 3. Safflower seeds from two different capitula

RESULTS AND DISCUSSIONS

Row spacing effects was significant for plants height, number of capitula per plant, number of seeds per plant and 100-seeds weight. The enlarging of row spacing leads to increasing of secondary branches number and seeds yield per plant (Table 1). Number of seeds per plant of safflower grown on 70 cm row spacing was in 1.4…1.7 times more than the same parameter of plants grown on row distance of 50 cm. However, the seeds obtained from safflower distanced by 70 cm, were smaller, and their 100-seeds weight was slightly less. In addition,

analogical results have been established in all variants: plants obtained from both treated and intact seeds.

The results indicated that decreasing of row spacing caused increasing of plant height. Our data are in correlation with similar trend determined by Amoughin et al. (2012) and Hamza (2015) and could be explained by creating early competition of plants for light absorption. In the growing season of 2016 the safflower plant had 1.3…1.5 times more height than the plant of 2015 (Ivanova, 2016), which can be explained by very different environmental conditions of these years.

Bioregulators application for pre-sowing treatment of seeds had no significant effect on plants height (Table 1). However, by applying GV there was obtained the highest number of capitula per plant and 100-seeds weight in both row spacing. The use of GG for pre-sowing treatment of safflower seeds contributed to reduction of entire determined traits in comparison with control variant (intact seeds) (Table 1). Earlier there was discovered that the influences of natural bioregulators on vegetable cultures are species specific (Mascenco et al., 2016).

Undoubtedly the application of natural bioregulators containing either polyphenolic (GV), or iridoid glycosides (GG) plays a vital role in physiological processes of plants and their productivity (Florea et al., 2015; Mascenco et al., 2015a; 2015b), but it is necessary to take carefully into account the type of bioregulator, dose and application schemes.

Presented in this paper results indicated that the pre-sowing treatment of seeds was not sufficient for boosting up production of safflower. Additional foliar treatment at flowering stage could be more effective in yield improvement of safflower (Khaki-Moghadam & Rokhzadi, 2015). Ullah & Bano (2011) reported that plant growth regulators applied during flowering as foliar spray significantly increased the 100-seed weight.

CONCLUSIONS

The results suggest that the plants height, numbers of capitula per plant, seeds per plant and 100-seed weight were significantly influenced by row spacing of safflower growth.

The increasing of row spacing increased number of secondary branches and seeds yield per plant.

Application of natural bioregulator GV allowed us to obtain highest numbers of capitula per plant and 100-seeds weight in both row spacing as well as in whole experiment.

In order to recommend an optimal scheme of bioregulators usage it is necessary to repeat field experimental studies in different growing seasons, since its effect greatly depends on environmental factors.

Table 1. Growth and yield parameters of safflower plants grown in different row spacing from intact seeds (control) and seeds gone through pre-sowing treatment with bioregulators (GV and GG)

Trait	Control		Variant GV		Variant GG	
Row spacing, cm	50	70	50	70	50	70
Plant height, cm	86.66	79.61	86.46	76.62	86.32	78.68
Number of branches per plant	9.46	10.50	8.90	9.69	9.02	9.31
Number of capitula per plant	9,9	15,93	10,28	16,55	8,83	13,65
Number of seeds per plant	98.41	171.25	91.43	149.11	88.49	128.19
Seed yield per plant, g	3.72±1.15	3.78±0.36	3.52±1.37	3.85±0.31	3.23±0.67	3.65±0.18
100-seeds weight, g	3.78±0.36	3.27±0.32	3.84±0.31	3.38±0.22	3.65±0.18	3.37±0.45

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