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INFLUENCE OF PREDECESSOR AND SOWING RATE ON SEED YIELD AND YIELD COMPONENTS OF CORIANDER *(CORIANDRUM SATIVUM* L.*)* IN SOUTHEAST BULGARIA

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Abstract

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A field trial was carried out during 2007-2010 in Southeast Bulgaria for estimation the influence of different predecessors (sunflower, stubble, coriander and sorghum) and the sowing rate (200, 250, 300 and 350 g.s/m^2) on the elements of productivity and seed yield of coriander. The results of some analysis showed that maximum number of umbel per plant, number of seeds per umbel, number of seeds per plant and weight seeds per plant was recorded after stubble predecessor and sowing rate of 300 g.s/m^2 when compared with other tested variants. The most suitable predecessor for the coriander is stubble and yield obtained surpassed those after predecessor sunflower, coriander and sorghum by 37, 21 and 50% respectively. The most effective sowing rate is 300 g.s/m^2 under the South-East Bulgaria conditions.

Key words: coriander, predecessor, sowing rate, elements of productivity, seeds yield

Introduction

Coriander *(Coriandrum sativum)* is one of the most important spice and medicinal plants grown in world. It is an annual and herbaceous plant, belonging to the Apiaceae family, which is cultivated mainly for its aromatic fruits (seeds).

There is abundant scientific literature on coriander's botanical (Diederichsen, 1996; Diederichsen and Hammer, 2003) and chemical (Kurkcuoglu et al., 2003) characteristics, but there is not much a small amount work done in concerning agronomic practices, with the exceptions of fertilization, which has been carefully studied under many environmental conditions (Carrubba, 2009; Gujar et al., 2005; Kumar et al., 2008) and sowing time (Bhadkariya et al., 2007; Carrubba et al., 2006; Khah, 2009; Zheljazkov et al., 2008).

Row spaces and plant density per unit are important in terms of fruits number sown per square meter, weight of fruits and branching ability of coriander. The row distances vary between 0.18 and 0.35 (Luayza et al., 1996).

Okut et al. (2005), who stated that, 30 cm row spacing should be optimal for achieving the highest yield, have studied the effect of different row spacing in Turkey. A field trail performed in Iran (Ghobadi and Ghobadi, 2010) showed that sowing densities were significant on seeds yield and structural elements of the yield. At 30 and 50 plants m^2 had the most seeds yield.

Sowing rate is the key factor effecting the yield and yield components of coriander. Tonev and Gramatikov (2008) investigated the effect of sowing rate on seed yield of coriander of Dodroudja region in Bulgaria and reported that highest yield were obtained with sowing rate of 250 g.s/m^2.

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The aim of the study was to establish the effect of different predecessors and sowing rates on the elements of productivity and the seeds yield of coriander under the Southeast Bulgaria conditions.

Material and Methods

The field experiment was held in the experimental of the selected area in Zhrebino village (Southeast Bulgaria) in the period 2007 - 2010. The test was performed by means of a block method with four replications; experimental field area – 15 m^2.

The four predecessors – sunflower, stubble, coriander and sorghum and four sowing rate - 200, 250, 300 and 350 g.s/m^2 were tested. The sowing was performed in October – November. All the stages of the established technology for coriander growing were followed.

The indices; height of plants, number of umbel per plant, number of seeds per umbel, number of seeds per plant, weight seeds per plant, seeds yield (kg ha^{-1}) were determined.

For determining the quantity dependence between the studied indicators, the experimental data was processed according to the ANOVA method of dispersion analysis, and the differences between the variants were determined by means of the Dunkan's Multiple Range Test at 0.05% P (Dunkan, 1955).

The period of study (2007-2010) comprised years, which differed significantly concerning the major meteorological factors (air temperature and precipitation sum) having an effect on coriander productivity.

The most favorable for the growth and development of the plants was reported to be 2007-2008, followed by 2009-2010 and 2008-2009 of the experiment, which influenced the growth processes and productive capabilities of coriander.

Results and Discussion

The values of the elements of productivity were presented in Table 1 in average for the three years. The data showed that lake the predecessor as well as sowing

Table 1
Yield components of coriander (mean for period 2007 - 2010)

Predecessor	Sowing rate, g.s/m^2	Components of productivity				
		Height of plants, cm	Number of umbel per plant	Number of seeds per umbel	Number of seeds per plant	Weight seeds per plant, g
Sunflower	200	74.0 [a]	18.5 [a]	23.0 [a]	320.0 [a]	0.77 [a]
	250	77.0 [b]	19.4 [b]	24.0 [b]	325.0 [b]	0.82 [b]
	300	77.5 [b]	20.0 [b]	25.4 [c]	332.7 [d]	0.95 [d]
	350	78.0 [b]	19.5 [b]	26.0 [c]	328.0 [c]	0.90 [c]
	$LSD_{5\%}$	*2.43*	*1.2*	*0.89*	*2.34*	*0.06*
Stubble	200	77.3 [a]	20.0 [a]	27.1 [a]	337.6 [a]	1.13 [a]
	250	77.6 [b]	22.0 [b]	28.0 [b]	340.2 [b]	1.16 [b]
	300	78.2 [c]	25.2 [d]	30.2 [c]	369.7 [d]	1.19 [c]
	350	81.4 [d]	23.1 [c]	28.4 [b]	360.0 [c]	1.12 [a]
	$LSD_{5\%}$	*0.68*	*1.91*	*0.59*	*1.2*	*0.03*
Coriander	200	75.4 [a]	20.2 [a]	23.1 [a]	330.0 [a]	0.78 [a]
	250	76.2 [a]	21.0 [a]	24.0 [b]	337.0 [b]	0.95 [b]
	300	80.0 [b]	23.5 [c]	26.7 [d]	346.8 [d]	1.09 [c]
	350	80.6 [b]	22.0 [b]	26.0 [c]	340.2 [c]	1.00 [b]
	$LSD_{5\%}$	*1.05*	*0.81*	*0.71*	*3.08*	*0.09*
Sorghum	200	73.0 [a]	17.7 [a]	20.1 [a]	300.0 [a]	0.59 [a]
	250	72.4 [a]	17.5 [a]	22.5 [b]	310.0 [b]	0.72 [b]
	300	72.0 [a]	18.0 [b]	23.0 [b]	313.5 [b]	0.80 [c]
	350	73.5 [a]	17.2 [b]	23.2 [b]	320.0 [b]	0.83 [d]
	$LSD_{5\%}$	*2.31*	*0.3*	*0.76*	*9.1*	*0.31*

rate had significant influence on the height of plants, number of umbel per plant, number of seeds per umbel, number of seeds per plant and weight seeds per plant of coriander. The height of plants varied depending on predecessor and sowing rate from 72 to 81.4 cm. The highest values of this index was reported in sowing rate 350 g.s/m^2 and predecessor stubble, while lowest – after predecessor sorghum.

Number of umbel per plant varied from 17.2 after predecessor sorghum to 25.2 numbers after predecessor stubble depending on sowing rate. Data statistical processing showed that the differences between variants were significant.

The highest values of the characteristic number of seeds per umbel were reported in sowing rate 300 g.s/m^2 and predecessor stubble – 30.2 number and in the rest variants the varied from 23 to 26 number , from 23.1 to 26.7 number and from 20.1 to 23.2 number after predecessor sunflower, coriander and sorghum respectively.

Number of seeds per plant varied depending on predecessor and sowing rate from 300 to 369.7 numbers. The highest values of this index was reported in sowing rate 300 g.s/m^2 and predecessor stubble, while lowest – after predecessor sorghum and sowing rate 200 g.s/m^2. The differences between the investigated variants were statistically significant.

Like the other structural elements of the yield, weight seeds per plant characteristic also had the highest values established in sowing rate 300 g.s/m^2 and predecessor stubble, i.e. 1.19 g. In the rest of the variants the values of that characteristic varied within the limits from 0.59 g (in sowing rate 200 g.s/m^2 and predecessor sorghum) to 1.09 g (in sowing rate 300 g.s/m^2 and predecessor coriander). Data statistical processing showed that the differences between all the studied variants were significant.

On analysing the data Table 2 it was ascertained that lake the predecessor (P) had statistic influence on the height of plants – η 96, the number of umbel per plant - η 93, the number of the seeds per umbel, the number of the seeds per plant and the seeds weight - η 98 as well as sowing rate (S) – η 90, η 74, η 94, η 91 and η 92 respectively.

Table 2
Analysis of variance for the elements of productivity

Elements of productivity	Source of variation	Sum of square SS	DF	Mean square MS	Sig of F	Partial ETA, Sqd η
Height of plants, cm	Predecessor - P	333.93	3	111.31	0	96
	Sowing rate - S	111.16	3	37.05	0	90
	P x S	64.44	9	7.16	0	84
	Residual	12.39	48	0.26		
Number of umbel per plant	Predecessor - P	251.54	3	83.85	0	93
	Sowing rate - S	55.94	3	18.65	0	74
	P x S	33.04	9	3.67	0	63
	Residual	19.26	48	0.4		
Number of seeds per umbel	Predecessor - P	321.26	3	107.09	0	98
	Sowing rate - S	86.66	3	28.89	0	94
	P x S	12.64	9	1.4	0	69
	Residual	5.66	48	0.12		
Number of seeds per plant	Predecessor - P	14599.3	3	4866.43	0	98
	Sowing rate - S	3459.11	3	1153.04	0	91
	P x S	1170.27	9	130.03	0	77
	Residual	355.3	48	7.4		
Weight seeds per plant	Predecessor - P	1.47	3	0.49	0	98
	Sowing rate - S	0.32	3	0.11	0	92
	P x S	0.11	9	0.01	0	79
	Residual	0.03	48	0		

Interaction - P x S - η 84, η 63, η 69, η 77 and η 79 was also significant for height of plants, number of umbel per plant, number of seeds per umbel, number of seeds per plant and weight seeds per plant of coriander.

Yields of coriander varied depending on the climatic conditions throughout the years and under the effect of predecessor and sowing rate (Table 3).

More favorable combination of the major meteorological factors (air temperature, soil and air humidity) during vegetation led to obtaining higher yields in the first year of the study compared to the second and the third.

The highest yield of seed (2508 kg ha^{-1}) were reported after predecessor stubble and sowing rate 300 g.s/m^2 and the lowest (1524 kg ha^{-1}) after sorghum and sowing rate 200 g.s/m^2. The differences between the investigated variants were statistically significant.

In the second experimental year (2008-2009), the yields obtained varied from 1124 to 1824 kg ha^{-1}, i.e. they were by 27 % lower in average in comparison with previous year. In the last year of the study (2009-2010), the yields obtained were within the limits of 1350 to 2200 kg ha^{-1}. Data statistical processing showed that the differences between all the studied variants were significant.

During the period of study (2007-2010) the highest yield depending on the sowing rates is obtained after predecessor stubble of 1991 to 2177 kg ha^{-1}, while after sunflower, coriander and sorghum – 1437-1597, 1618-1806 and 1335-1444 kg ha^{-1} respectively. Most suitable sowing rate for coriander is 300 g.s/m^2.

On analysing the data Table 4 it was ascertained that lake the years (Y) with their climatic conditions had

Table 4
Analysis of variance for seeds yield for the period 2007 – 2010

Source of variation	Sum of square SS	DF	Mean square MS	Sig of F	Partial ETA, Sqd η
Predecessor - P	12957276	3	4319092	0	99
Sowing rate - S	736428.5	3	245476.2	0	94
Years - Y	6847175	2	3423587	0	99
P x S	39887.23	9	4431.91	0	48
P x Y	843126.5	6	140521.1	0	95
S x Y	39907.67	6	6651.28	0	48
P x S x Y	87866.33	18	4881.46	0	67
Residual	44054.5	144	305.93		

Table 3
Seeds yield, kg ha^{-1}

Predecessor	Sowing rate, g.s/m^2	Years of study			Average for the period, kg ha^{-1}
		2007 - 2008	2008 - 2009	2009 - 2010	
Sunflower	200	1650 ^{a}	1256 ^{a}	1405 ^{a}	1437
	250	1740 ^{b}	1300 ^{c}	1556 ^{c}	1532
	300	1822 ^{c}	1328 ^{d}	1642 ^{d}	1597
	350	1701 ^{b}	1276 ^{b}	1390 ^{b}	1456
	LSD 5%	*63.1*	*13.7*	*12*	
Stubble	200	2334 ^{a}	1630 ^{b}	2010 ^{b}	1991
	250	2482 ^{c}	1755 ^{c}	2012 ^{c}	2083
	300	2508 ^{d}	1824 ^{d}	2200 ^{d}	2177
	350	2370 ^{b}	1612 ^{a}	2030 ^{a}	2004
	LSD 5%	*25.9*	*16.5*	*17.3*	
Coriander	200	1723 ^{a}	1495 ^{a}	1635 ^{a}	1618
	250	1860 ^{c}	1534 ^{b}	1720 ^{b}	1705
	300	1930 ^{d}	1627 ^{c}	1862 ^{c}	1806
	350	1805 ^{b}	1500 ^{a}	1710 ^{a}	1672
	LSD 5%	*22.5*	*15.1*	*13.8*	
Sorghum	200	1524 ^{a}	1130 ^{a}	1350 ^{a}	1335
	250	1553 ^{b}	1162 ^{b}	1421 ^{b}	1379
	300	1620 ^{c}	1211 ^{c}	1500 ^{c}	1444
	350	1530 ^{a}	1124 ^{a}	1382 ^{a}	1345
	LSD 5%	*18.7*	*12.8*	*17.7*	

statistic influence on the seeds yield – η 99, as well as predecessor (P) – η 99 and sowing rate (S) – η 94.

Interaction - P x Y - η 95 was also significant for seeds yield as well as between P x S x Y - η 67, while between P x S and S x Y - η 48.

Conclusions

Both the experimental factors (predecessor and sowing rate) had a significant influence on seed yield and yield components of coriander, grown in the conditions of south – east Bulgaria.

Maximum number of umbel per plant, number of seeds per umbel, number of seeds per plant and weight seeds per plant was recorded after stubble predecessor and sowing rate of 300 g.s/m^2 when compared with other tested variants.

During the period of study (2007-2010) the highest seeds yield of 2177 kg ha^{-1} were obtained after stubble predecessor and sowing rate of 300 g.s/m^2 and the lowest one – of 1335 kg ha^{-1} after sorghum predecessor and sowing rate of 200 g.s/m^2

The most suitable predecessor for the coriander is stubble and yield obtained surpassed those after predecessor sunflower, coriander and sorghum by 37, 21 and 50 % respectively. The most effective sowing rate is 300 g.s/m^2 under the Southeast Bulgaria conditions.

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