Journal of Agricultural Sciences
Vol. 47, No 2, 2002
Pages 113-120

UDC: 631.531:631.586:633.875
Original scientific paper

THE INFLUENCE OF BASIC METEOROLOGICAL ELEMENTS AND SEEDING DENSITY ON YIELD AND QUALITY OF FENUGREEK SEED *(Trigonella foenum graecum L.)*

Dj. Glamočlija[1], Radojka Maletić[1] and R. Jevdjović[2]

Abstract: Results of two-year investigations (2000 and 2001) on the influence of seeding method and basic meteorological elements (precipitation and temperature) on yield and quality of fenugreek seed *(Trigonella foenum graecum L.)* are presented in this paper.

Considerably higher yield of fenugreek seed in all variations was obtained in the second study year, which was probably caused by more favorable precipitation during vegetation period. Average temperature during vegetation period was similar in both study years, therefore it could not have influenced significantly the differences in yield and quality of seed. The highest seed yield was achieved in both study years in case of seeding method with 50 cm distance between seeding rows and 10 cm distance between plants in a row. Reduction of the distance below 50 cm caused more significant decrease of seed yield compared to the condition when the distance was increased. Similar results were obtained by Rajčić and Jocković (1990) in soybean, Lugić et al. (1996) in red clover and Slowinsky et al. (1996) in alfalfa production to be used as seed raised on vegetation areas of different surfaces. The conclusion was that raising plants in higher density caused considerable decrease of seed yield.

Fenugreek seed produced in the year 2000 had lower absolute mass, but better germination energy, as well as total germination, compared to the second study year despite better conditions of natural moisterizing. Concerning variations of distance between seed rows in both study years, fenugreek seed obtained from 50 x 10 cm variation had best quality traits.

Key words: fenugreek, seeding density, seed yield, seed quality.

[1] Djordje Glamočlija, PhD., Professor, Radojka Maletić, PhD., Assistant Professor, Faculty of Agriculture, Nemanjina 6, 11081 Belgrade-Zemun, FR Yugoslavia

[2] Radosav Jevdjović, M.Sc., Institute for Medicinal Plant Research "Dr Josif Pančić", Tadeuša Košćuška 1, 11000 Belgrade, FR Yugoslavia

I n t r o d u c t i o n

Fenugreek *(Trigonella foenum gracum L.)* is annual herbaceous plant from the *Fabaceae* family. It is greatly used for medicinal purposes and cosmetics. Also, vegetative biomass of fenugreek can be used for livestock nutrition, and in veterinary medicine for drugs production.

In our climatic conditions, fenugreek is not a part of spontaneous flora but is exclusively raised. It must be pointed out that issue of fenugreek production technology has not been investigated enough in Yugoslavia. On the other hand, this issue hes been investigated to a higher extent in the world, however, the results were scarce.

The aim of our research was to investigate the effect of various seeding methods as well as effect of temperature conditions and precipitation during vegetation period on yield and quality of fenugreek seed in conditions of natural moisturizing.

Material and Methods

The trial was designed on production locations of the Institute for Medicinal Plant Research "Dr Josif Pančić" in Pančevo, on marsh dark fertile soil type. The investigations lasted two years, in 2000 and 2001. The following five treatments of different distances between seed rows with permanent distance between plants in a row were investigated: 30 x 10 cm; 40 x 10 cm; 50 x 10 cm; 60 x 10 cm; 70 x 10 cm.

Trial plots were set randomly by block system design in four replications. Domestic fenugreek seed that was used in this trial comes from the collection of the abovementioned Institute.

The cultivation of soil, basic and preseeding, was carried out by standard method for cultivated plants. Manual seeding of fenugreek in both study years was carried out at the beginning of April. Seed of 99% cleanliness and 98% germination was used in this trial. Seeding depth was 3 cm. During vegetation period, soil of the crops was loosened manually several times, therefore no chemical preparations were used for the protection of crops from weeds, pests and pathogenic diseases (P a v l o v i ć et al., 1998).

During vegetation period of fenugreek (April-August) in the first study year, the precipitation of 107 mm and average temperature of 21.2^0C were registered. In the second study year, for the same period of time, the precipitation of 320 mm was registered and average temperature of 20.7^0C was approximately at the level of previous year.

The harvest of fenugreek in both years was carried out in August, 18. Natural seeding material was processed to standard quality. From each plot

10x100 seeds were counted. After weighing of absolute bio-mass on precise scale, seed was germinated in Petri dishes on filter paper and constant temperature of 20^0C. The following traits were determined: seed germination energy and total germination.

The obtained data were processed by the method of mathematical-statistical processing (Hadživuković, 1991). Measures of central tendency and dispersion of investigated traits were defined by parameters of descriptive statistics ($\overline{X}$, C_v). Statistical significance of differences between investigated factors was calculated by the model of variance analysis (Snedecor, Cochran, 1967), mathematical form:

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk} \qquad (1 = 1, 2; j = 1, 2, 3, 4, 5; k = 1, 2, ..., 10).$$

The evaluation of significance was carried out based on F-test and LSD-test for the threshhold of risk of 1%. Based on analysed parameters, correlation between investigated traits of fenugreek seed was determined, where correlation significance was tested for the risk level of 5%.

Meteorological conditions during the trial

Basic meteorological data were obtained from meteorological station in Pančevo located in the vicinity of trial fields.

Precipitation. Total precipitation for the vegetation period of fenugreek during the frist study year was considerably below average for Pančevo area (Table 1).

Tab. 1.- Precipitation sum for the period April-August, per month and decade, mm

Year	2000				2001			
Month	Decade				Decade			
	I	II	III	Sum	I	II	III	Sum
April	10	-	7	17	5	17	9	31
May	23	-	14	37	8	5	11	34
June	-	-	17	17	48	19	16	83
July	-	16	1	17	111	10	28	149
August	14	-	5	19	2	14	7	23
Sum	-	-	-	107	-	-	-	320

During the year 2000, there were dry periods during entire vegetation period, starting with May until fenugreek harvest. In the second study year, during summer months of June and July, precipitation sum was 232 mm, which was considerably above the average for this region and above the optimal needs of plants.

Temperature conditions during both study years were at the level the average as regards the quantity and distribution favorable for the development of plants in the field (Tab. 2).

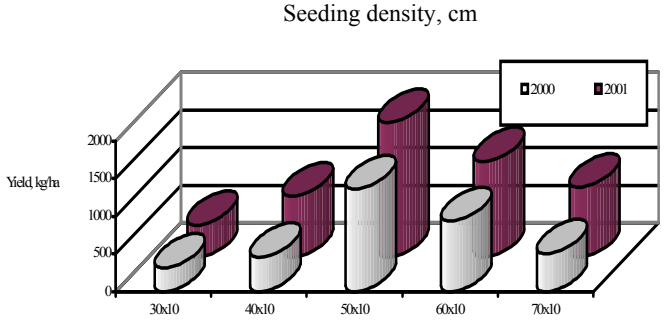
Tab. 2.- Mean air temperatures for the period April-August, per month and decade, t^0C

Year	2000				2001			
Month	Decade				Decade			
	I	II	III	$\overline{X}$	I	II	III	$\overline{X}$
April	10.8	18.0	18.2	15.7	11.1	17.6	19.0	15.9
May	17.8	20.0	21.7	19.8	17.6	19.8	19.3	18.9
June	20.9	22.0	21.7	21.5	20.7	21.9	22.1	21.6
July	24.3	26.2	23.0	24.5	25.0	20.1	22.9	22.7
August	23.7	26.2	23.0	24.3	24.1	25.8	23.2	24.4
Average	-	-	-	21.2	-	-	-	20.7

Results and Discussion

Average annual values of traits included in this investigation (yield and mass of seed, germination energy and total germination), as well as variation are presented in Table 3.

Considerably higher yield of fenugreek seed was produced in the second study year, probably as a result of higher precipitation sum (320 mm) compared to the previous year (107 mm) 2000. Average values of yield are statistically considerably different depending on the seeding distance, $P<0.01$ (Tab. 3).



Seeding density, cm

Graph. 1. – Yield of fenugreek seed, kg/ha

The highest yield of fenugreek seed in both study years was achieved with seeding distance between rows of 50 x 10 cm (Graph. 1). Decrease or increase of distance between rows induced the decrease of fenugreek seed yield. The

obtained results indicate significant differences of average fenugreek seed yield, depending on the year, seeding distance and their interaction (P<0.01).

T a b. 3. - Parameters of fenugreek seed yield and quality

Property	Year	Seeding density (cm) 30x10	40x10	50x10	60x10	70x10	$\bar{x}$	C_V (%)
Yield, kg/ha	2000	313.25	454.50	1358.25	932.25	503.75	712.40	55.74
	2001	429.00	809.25	1785.50	1270.50	928.25	1049.5	45.62
$\bar{x}$		371.12	631.88	1571.88	1101.38	716.00		
C_V (%)		19.75	30.02	14.67	17.72	30.12		
Weight, 1000 seed	2000	12.46	16.62	18.78	16.63	13.46	15.589	17.47
	2001	13.41	17.96	21.51	17.52	14.23	16.927	17.73
$\bar{x}$		12.94	17.29	20.15	17.07	13.85		
C_V (%)		5.66	7.23	11.20	7.78	3.850		
Germin. energy	2000	78.60	90.70	96.00	90.30	87.2	88.56	7.24
	2001	74.80	85.30	94.30	84.70	80.10	83.40	9.34
$\bar{x}$		76.7	88.0	95.15	87.50	83.65		
C_V (%)		5.34	5.16	1.91	5.97	6.75		
Total germination	2000	83.60	94.3	98.0	94.5	91.1	92.3	5.88
	2001	75.9	91.1	96.4	91.2	84.3	87.78	9.06
$\bar{x}$		79.75	92.7	97.2	92.85	87.70		
C_V (%)		6.97	3.67	1.69	3.62	5.43		

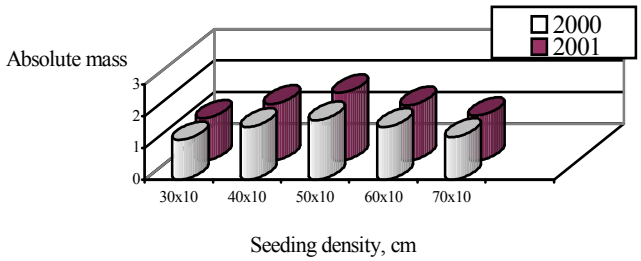
Property	$LSD_{0.01}$		
	Year	Seeding density	Year x Seeding density
Yield	65.9054**	104.206**	147.369**
Weight	0.0602**	0.0951**	0.1345^{NZ}
Germination energy	1.9999**	3.1621**	4.4719^{NZ}
Total germination	1.6239**	2.5676**	3.6311**

** Significant at the level of 1%
^{NZ} Stat. non significant

Weight of 1000 seeds expressed significant differences in average values, depending on seeding density as well as years. In both study years the highest absolute weight was registered in seed raised in rows 50 x 10 cm. Also, seed produced in the year 2001, in all seeding distances, had the highest absolute weight (Graph. 2).

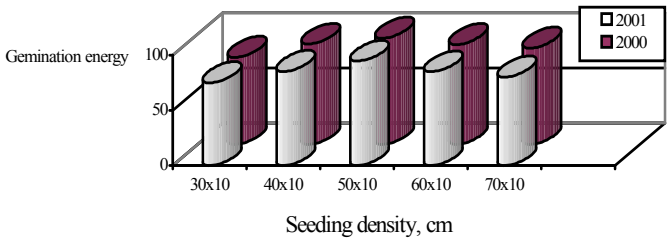
Mean value for germination energy of fenugreek seed was higher in the year 2000. This indicates that low precipitation during vegetation period of fenugreek

was favorable for obtaining seed of better quality (better germination energy). Seed obtained from rows with distance of 50 x 10 cm had better germination



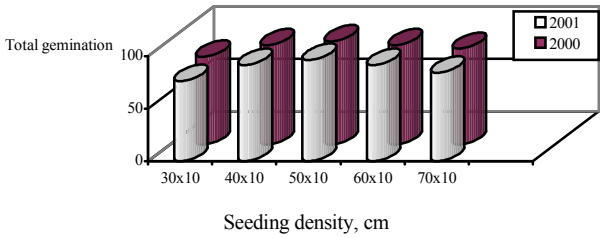
Graph. 2. - Absolute mass of fenugreek seed

energy (Graph 3). With the increase or decrease of seeding density, germination energy of the seed decreased. Registered results indicate statistically very significant differences of germination energy values, depending on the year and seeding density ($P<0.01$), whereas their interaction showed no significance ($P>0.05$), table 3.



Graph. 3. - Germination energy of fenugreek seed

Average total germination of fenugreek seed also provided for the best effect of germination in the year 2000 in all seeding distances, whereas seed from crops raised at the distance of 50 x 10 cm had the best value of total germination (Graph. 4). The obtained results indicate significant differences between average values of total germination of fenugreek seed, depending on year, seeding distance and their interaction ($P<0.01$), (Tab. 3).



Graph. 4. - Total germination of fenugreek seed

Also, it was confirmed that all factors included in the investigation were mutually very determined, therefore calculated correlation coefficients indicate strong and significant correlations ($r_{total\ germ.;\ weight} = 0,67^*$, $r_{germ.energy;weight} = 0,66^*$ and $r_{total\ germ.\ ;\ germ.\ energy} = 0,92^*$).

Conclusion

Based on the obtained results of the investigation of mutual effect of seeding density and basic meteorological elements on yield and quality of fenugreek seed, the following can be concluded:

- Higher precipitation amount determines higher yield and weight of 1000 seeds of fenugreek.
- The highest yield and weight of 100 seeds were obtained from crops at a 50-cm seeding distance between rows.
- The best quality traits (germination energy and total germination), also were obtained from crops at a 50-cm seeding distance between rows.
- Less precipitation was favorable for obtaining better quality seed.

REFERENCES

1. Hadživuković, S. (1991): Statistički metodi. Drugo prošireno izdanje. Poljoprivredni fakultet, Novi Sad.
2. Lugić, Z, Krstić, O, Tomić, Zorica i Radović, Jasmina (1996): Uticaj načina setve na produkciju suve mase i semena crvene deteline. Zbornik radova, sv. 26, str. 259-264, Novi Sad.
3. Pavlović, R, Jevdjović, R. i Maletić, Radojka (1998): Mogućnosti gajenja peršuna lišćara u brdskoplaninskim uslovima Srbije. Savremena poljoprivreda, vol. 46, str. 329-332, Novi Sad.
4. Rajičić, M. i Jocković, Dj. (1990): Uticaj gustine setve i razmaka redova na kvalitativna svojstva soje. Uljarstvo, 27, br. 3-4, str.33-38. Beograd.
5. Snedecor, G. W. and Cochran, W. G. (1967): In ″Statistical Methods″ ed. 6 Oxford and IBH Publishing Co. Calcutta.
6. Sowinski, J, Gospodarczyk, F. and Nowak, W. (1996): The yield of lucerne (*Medicago sativa*) seeds depending on sowing and method of growing. Zbornik radova, sv. 26, pg. 167-174, Novi Sad.

Received September 18, 2002
Accepted October 21, 2002

UTICAJ NAČINA SETVE I OSNOVNIH METEOROLOŠKIH ELEMENATA NA PRINOS I KVALITET SEMENA PISKAVICE (*Trigonella foenum graecum L.*)

Đ. Glamočlija,[1] Radojka Maletić[1] i R. Jevdjović[2]

R e z i m e

Dati su rezultati dvogodišnjih istraživanja (2000. i 2001.) uticaja osnovnih meteoroloških elemenata (padavine i temperature) i gustine setve (sklopa) na prinos i kvalitet semena piskavice (*Trigonella foenum graecum L.*). Za istraživanje je korišćeno seme piskavice koje se umnožava u kolekciji Instituta za lekovito bilje u Pančevu. Proučavan je uticaj gustine setve, količine padavina i temperature u toku vegetacije na prinos (kg/ha) i kvalitet (energija klijanja, ukupno klijanje i masa) semena piskavice. Radjeno je pet varijanti gustine setve (30x10 cm, 40x10 cm, 50x10 cm, 60x10 cm i 70x10 cm). Svaka varijanta obavljena je u četiri ponavljanja. Priprema zemljišta za setvu uradjena je uobičajenom metodom. Setva je obavljena u obe godine istraživanja četvrtog aprila na dubini od 3 cm. Za setvu je korišćeno seme čistoće 99% i klijavosti 98%. Žetva je obavljena 18.08 u obe godine istraživanja.

Značajno veći prinos semena piskavice postignut je u drugoj godini istraživanja što je verovatno posledica veće količine padavina u toku vegetacionog perioda. Prosečna temperatura u toku vegetacionog perioda bila je približna u obe godine istraživanja te ona nije značajno uticala na prinos. Najveći prinos ostvaren je na rastojanju setve 50x10 cm u obe godine istraživanja. Smanjenjem rastojanja setve znatno brže opada prinos semena piskavice nego povećanjem rastojanja setve.

Seme proizvedeno u toku 2000. godine imalo je manju masu ali bolju energiju klijanja i ukupno klijanje. Posmatrano po varijantama rastojanja setve u obe godine istraživanja najbolje kvalitativne osobine imalo je seme dobijeno sa rastojanja 50x10 cm.

Primljeno 18. septembra 2002.
Odobreno 21. oktobra 2002.

[1] Dr Djordje Glamočlija, profesor, dr Radojka Maletić, docent, Poljoprivredni fakultet, Nemanjina 6, 11081 Beograd-Zemun, SR Jugoslavija

[2] Mr Radosav Jevdjović, Institut za proučavanje lekovitog bilja »Dr Josif Pančić«, T. Košćuška 1, 11000 Beograd, SR Jugoslavija