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EFFECT OF MATURATION PERIOD ON SEED QUALITY; OPTIMUM TIME FOR DESICCATION IN SUNFLOWER (*Helianthus annuus* L.) GENOTYPES

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SUMMARY

To harvest a sunflower crop, it is important to bring moisture content, *i.e.*, moisture level in leaves, stems, heads and seed, to a level that permits normal work of combine harvester.

In 2003, an experiment was established at Rimski Šančevi experiment field to determine optimum time for desiccation of sunflower. The experiment included 10 parental components, which are grown at large area for F_1 seed production.

A comparative study showed that oil content, protein content and seed viability change with seed maturity.

The experiment indicated that the values of oil and protein contents and seed viability stop increasing when the average seed moisture reaches 24%. This moment was concluded to represent the optimum time for desiccation of sunflower seed crop.

Key words: sunflower, seed, viability, moisture content, oil, proteins

INTRODUCTION

Success in sunflower seed production depends to a large measure on organization of work. Good organization is a prerequisite for successful production. Good organization implies correct and timely performance of all technological operations involved in seed production.

Seed crop desiccation is an important technological operation. It accelerates crop maturation, reduces the occurrence of pathogens on seed and seed shattering and creates good conditions for successful combine harvesting.

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Introduction of chemical desiccation has solved many problems in sunflower harvest. On the other hand, early desiccation may cause reduction in yield level and quality while late performance makes desiccation ineffective (Miklič, 2001).

Morozov (1973) found that low temperature, rain and wind negatively affect desiccation. He maintained that the optimum time for desiccation is when seed moisture reaches 25-30%. Hill *et al.* (1974) identified major problems of late sunflower harvest: bird damage, increase in seed moisture, leading directly to self-heating and increased costs of drying, and interference with field operations for other crops (corn harvest, primary tillage, seedbed preparation and planting of winter cereals). According to these authors, these problems justify desiccation practice, especially in seed production. According to Palmer and Sanderson (1976), desiccation applied at seed moisture of 25% fastens the harvest by 10-11 days, improves harvester efficiency and slightly increases the yield in relation to control while maintaining seed viability.

Smirnova and Malyhin (1972) found that desiccation does not reduce seed viability, even after three years of storage. They also claimed that desiccation at seed moisture between 26 and 33% may increase oil content by 1% while treatment between 55 and 65% may reduce oil content by 3% (Smirnova and Malyhin, 1974)

Maširević and Glušac (1999) recommend desiccation because it ensures high seed quality and reduces the extent of seed damage. The latter decreases the occurrence of saprophytes, which in their turn reduce seed viability, cause oil oxidation and impair seed health and market quality.

The objective of this study was to determine the optimum time for desiccation treatment in seed production. It is assumed that the tested genotypes differ in their reaction to the time of treatment. The obtained results should provide helpful hints for domestic sunflower seed production.

MATERIAL AND METHOD

The experiment was established at Rimski Šančevi experiment field in 2003. It included 5 cytoplasmic male sterile lines and 5 restorer lines. Seed for testing was taken from heads harvested at 7-day intervals starting 7 days after end of flowering. Sample size was 5 heads per genotype. Threshed seeds from these heads were bulked to make average samples for determinations of moisture content, oil content, protein content and percentage of viability.

Moisture content in sunflower seed was determined by the classical method (6 hours of drying at 103°C). The obtained values were expressed in percentage.

Oil content was determined by the method of Ruškovski and expressed in relative values.

Protein content was determined by the method of Kjeldahl, using a VAP-50-Gerhardt i apparatus, expressed in relative values.

Seed viability was tested by the standard method, according to Regulations of Seed Quality of Agricultural Crops (Official Gazette of SFRY, no. 47/87).

The obtained results were subjected to the regression analysis (Hadživuković, 1991).

RESULTS AND DISCUSSION

Results

The obtained results (Table 1) indicated that marked reduction in moisture occurred in the seed of the *cms* lines after 21 days of observation. Exceptions were genotypes PH-BC2-91 and HA-19. In PH-BC2-91, moisture dropped abruptly 35 days after flowering. In HA-19, moisture dropped abruptly 21 days after flowering.

Table 1: Seed moisture (%)

No.	Genotype	Days after flowering							
		7	14	21	28	35	42	49	56
1	HA-NS-26	65.86	54.10	36.33	23.16	13.89	10.91	5.54	6.64
2	OCMS-98	79.95	74.28	51.46	39.62	16.33	10.49	4.96	5.49
3	OD-3369	74.40	60.58	44.49	29.98	9.76	5.41	4.44	6.71
4	PH-BC2-91	83.24	74.98	68.97	58.45	37.36	36.56	8.97	9.55
5	HA-19	60.90	50.04	19.47	19.90	14.10	6.92	5.05	6.44
6	RHA-SNRF	82.41	78.16	67.28	57.23	46.40	28.60	17.95	11.30
7	RHA-CDN	82.06	76.72	61.85	54.48	40.74	19.83	13.74	10.41
8	RHA-ST-59	82.96	73.40	60.55	49.41	25.54	11.61	8.69	8.62
9	RHA-113 N	82.02	64.97	52.45	39.47	18.99	11.80	4.95	6.20
10	RHA-RU-3	65.57	55.40	41.67	30.27	19.04	5.38	6.03	8.68

In the case of the restorers RHA-ST-59 and RHA-113 N (Table 1), moisture dropped abruptly 35 after flowering. In RHA-SNRF, moisture reduction was gradual. In RHA-CDN, noticeable reduction in seed moisture occurred 42 days after flowering. In RHA-RU-3, moisture content dropped gradually but at a higher rate of decrease than it was the case with the other restorers.

Table 2: Oil content in seed (%)

No.	Genotype	Days after flowering							
		7	14	21	28	35	42	49	56
1	HA-NS-26	28.17	38.64	43.07	39.84	39.55	41.28	38.89	39.46
2	OCMS-98	17.46	36.35	46.68	47.20	48.00	48.40	48.33	47.38
3	OD-3369	32.08	43.08	51.22	50.79	49.13	48.58	50.98	48.26
4	PH-BC2-91	5.77	22.15	25.54	36.58	42.69	41.35	43.16	42.76
5	HA-19	36.91	39.73	34.90	38.94	40.60	37.76	39.59	38.17
6	RHA-SNRF	5.67	15.26	33.15	38.13	41.88	45.45	44.87	45.36
7	RHA-CDN	5.73	16.90	37.38	39.66	44.47	44.23	45.19	44.20
8	RHA-ST-59	9.59	26.11	38.89	44.78	50.42	43.91	49.02	44.22
9	RHA-113 N	12.58	39.29	46.80	50.56	51.99	49.10	49.11	49.61
10	RHA-RU-3	41.78	46.94	53.73	54.74	53.53	55.05	54.08	53.13

In all lines under observation moisture content stabilized 49 days after flowering. Here it should be mentioned that the heads harvested 56 days after flowering were collected after a rain which fell the previous day.

Regarding oil content in seed (Table 2), high values at the beginning of the observation period were characteristic for the lines HA-NS-26, OD-3369, HA-19 and RHA-RU-3. It was evident that oil content increased in all lines, stabilizing 35 days after.

The results for protein content in seed (Table 3) indicate that 14 days after flowering all lines reached their characteristic values.

Table 3: Protein content in seed (%)

No.	Genotype	Days after flowering							
		7	14	21	28	35	42	49	56
1	HA-NS-26	11.55	20.83	19.64	20.34	21.35	17.80	21.99	21.84
2	OCMS-98	9.46	21.05	20.02	20.30	21.13	21.88	23.77	23.85
3	OD-3369	9.30	19.76	21.19	19.81	21.22	22.90	21.09	21.77
4	PH-BC2-91	7.56	18.75	17.65	18.67	19.64	20.29	19.18	19.55
5	HA-19	7.66	18.68	18.02	20.61	19.23	19.98	20.24	20.18
6	RHA-SNRF	10.14	15.28	17.20	18.55	19.23	17.80	19.93	19.91
7	RHA-CDN	8.28	15.04	15.57	22.23	19.79	18.25	18.18	18.23
8	RHA-ST-59	9.00	16.16	14.28	16.28	15.21	14.83	16.00	16.10
9	RHA-113 N	8.99	17.69	15.34	17.76	18.27	16.83	18.23	18.00
10	RHA-RU-3	9.73	17.29	17.18	16.57	17.05	17.30	17.46	17.44

Regarding seed viability (Table 4), it can be seen that viability was lowest directly after flowering and it increased as the seed matured. The line HA-19 was an exception in which highest viability was obtained after flowering, the value going down with seed maturation. Also, the viability values of the restorers at the beginning of the observation period were lower than those found for the *cms* lines. The values were reversed at the end of seed maturation.

Table 4: Sunflower seed viability (%)

No.	Genotype	Days after flowering							
		7	14	21	28	35	42	49	56
1	HA-NS-26	49	68	83	80	79	80	85	92
2	OCMS-98	25	77	81	83	84	87	88	87
3	OD-3369	66	73	88	86	87	89	90	87
4	PH-BC2-91	0	4	37	47	74	74	86	85
5	HA-19	78	67	55	52	48	27	28	30
6	RHA-SNRF	0	6	27	61	82	88	88	88
7	RHA-CDN	0	3	68	56	90	87	87	86
8	RHA-ST-59	0	16	54	71	72	85	88	88
9	RHA-113 N	0	9	70	73	82	82	81	81
10	RHA-RU-3	30	45	76	54	80	88	90	89

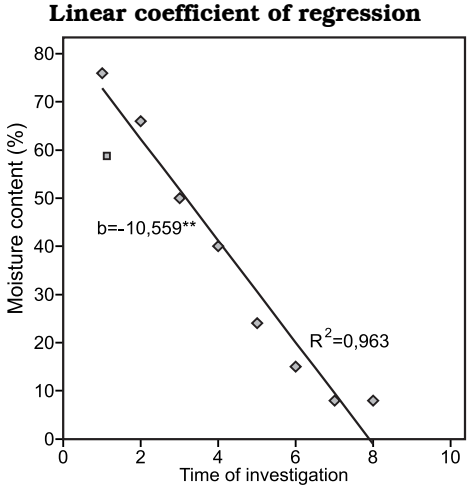

Figure 1: Moisture content in see

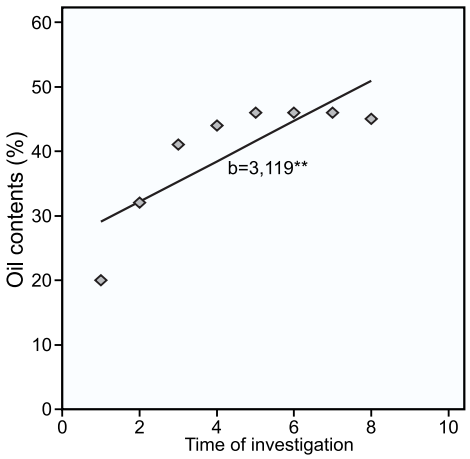

Figure 2: Oil content in seed

Based on the obtained data, the linear coefficient was significant for protein content (P<0.05; Figure 3) and highly significant for moisture content (Figure 1), oil content (Figure 2) and seed viability (Figure 4). Regression coefficient was highest for moisture content, followed in decreasing order by seed viability, oil content and protein content.

The obtained results showed that highest reliability of the model was obtained for moisture content and viability, for which the coefficients of determination were 0.963 and 0.819, respectively. Regarding oil and protein contents, the reliability of the model was relatively lower, with the coefficients of determination of 0.665 and 0.527, respectively.

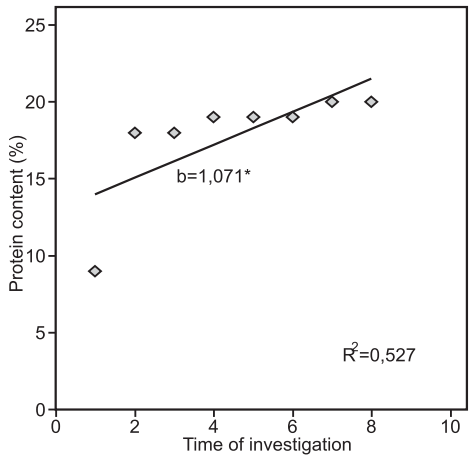

Figure 3: Protein content in seed

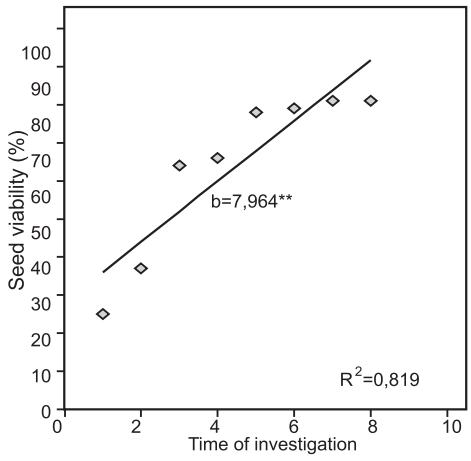

Figure 4: Viability of sunflower seed

DISCUSSION

All genotypes reached their average values of oil content 42 days after flowering. The average value was 46%. The obtained results indicated two things: 1) oil content and its rate of accumulation in seed depended considerably on seed maturation, *i.e.*, reduction of moisture content in seed, and 2) early desiccation would interrupt the process of oil accumulation which would affect oil quality. Contrary to these results, Miklič (2001) claims that there is no noteworthy increase in oil content 14 days after flowering. Smirnova and Malyhin (1974) reported that desiccation at seed moisture of 26-33% may increase oil content by 1%, while the treatment at 55-65% seed moisture may reduce oil content by 3%.

The obtained results showed that protein content in seed increased significantly only in the period of 14 days after flowering. After that, protein content remained at the level between 18 and 20%. This finding confirms previous results of other authors (Miklič, 2001; Singh *et al.*, 1988). The results also showed that if protein content alone were considered, it would be feasible to perform desiccation already 2-3 weeks after flowering.

Regarding seed viability, highest values were obtained 49 days alter flowering. The average viability was 81%. This value would have been higher if we had excepted the line HA-19 in which viability goes down with seed maturation. Evidently, a stress situation occurred 14 days after the treatment which caused a rapid reduction in seed moisture resulting in reduced viability. This negative trend was observed in this line only for seed viability and not for the other parameters under observation.

Similarly to the results for oil content, seed viability too depended considerably on seed moisture, *i.e.*, it increased with moisture decrease. If desiccation had been performed early during maturation (when seed moisture is high), marked reduction in seed viability would have occurred. Conversely, Crnobarac (1987) states that high quality seed may be obtained with harvest 30 days after flowering, when moisture content in seed is 59%. Rađenović (1989) asserts that the harvest at 50% moisture produces high quality seed but this early harvest tends to reduce seed level. Gupta and Kole (1982) believe that early harvest causes rapid deterioration in seed quality (rapid aging).

CONCLUSION

Following conclusions were drawn on the basis of the obtained results:

- Reduction in seed moisture increases the contents of oil and proteins as well as seed viability.
- Protein content stabilizes sooner than oil content and seed viability.
- With respect to quality standards, oil content and seed viability stabilize approximately at the same time.

- As indicated by the obtained results, desiccation should be performed when seed moisture comes down to 24%.

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LA INFLUENCIA DE MADUREZ EN LA CALIDAD DE SEMILLA Y EL ÓPTIMO MOMENTO PARA LA DESECACIÓN EN CIERTOS GENOTIPOS DE GIRASOL (*Helianthus annuus* L.)

RESUMEN

La principal condición para la siega es que el contenido de humedad en la planta, es decir en la hoja, tallo, capítulo y la semilla, caiga hasta el nivel que permita el funcionamiento normal de la segadora-trilladora.

A lo largo del año 2003, fue sembrado el campo experimental en Rimski èevi, para determinar el óptimo momento para la desecación química de las plantaciones. Se han sembrado 10 diferentes componentes parentales, representadas en mayores superficies en la producción de la semilla de girasol F_1.

Por medio de una investigación comparativa, hemos llegado hasta los datos de que el contenido de aceite, proteinas, tanto como el porcentaje de germinación de la semilla, cambia por causa de maduración de la semilla.

Las pruebas han demostrado que en las condiciones de una humedad promedia de la semilla, de 24%, no se presenta el seguido crecimiento del contenido de aceite y de proteínas tanto como el porcentaje de germinación. Este momento representa el óptimo momento para la desecación de la plantación de semilla de girasol.

EFFET DE LA PÉRIODE DE MATURATION SUR LA QUALITÉ DES GRAINES; TEMPS OPTIMAL POUR LA DESSICCATION CHEZ LES GÉNOTYPES DU TOURNESOL (*Helianthus annuus* L.)

RÉSUMÉ

Pour récolter le tournesol, il est important d'amener le contenu d'humidité, *i.e.* le niveau d'humidité dans les feuilles, les tiges, les têtes et les graines à un niveau qui permette le travail normal de la moissonneuse-batteuse.

Une expérience a été effectuée en 2003 dans un champ expérimental à Rimski Šančevi pour déterminer le temps optimal de dessiccation du tournesol. L'expérience portait sur 10 composantes parentales cultivées sur une grande surface pour la production de graines F_1.

Une étude comparative a démontré que le contenu d'huile, le contenu de protéine et la viabilité de la semence changeaient avec la maturité de la semence.

L'expérience a indiqué que les valeurs de contenus d'huile et de protéine et la viabilité de la semence cessent d'augmenter quand l'humidité moyenne de la graine atteint 24%. Ce moment a été déterminé comme celui représentant le temps optimal pour la dessiccation de la culture de la graine de tournesol.