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EFFECT OF TIME OF DESICCATION ON OIL CONTENT IN DIFFERENT SUNFLOWER HYBRIDS

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SUMMARY

Chemical desiccation with Reglone Forte has been tried in production fields under four sunflower hybrids. Reglone Forte (2 l/ha) was applied at 7-day intervals from the end of pollination till maturity. Seed moisture was determined prior to each treatment. Seed oil content was determined at maturity, using the method of nuclear magnetic resonance. The highest oil content was found in the control, the lowest in the treatment 7 days after flower (DAF). The absence of significant differences among treatments 21 DAF, 28 DAF and the control was an indication that there was no large increment in oil content in the period after the average seed moisture reached 44.34% and maturity. Considering individual hybrids, there was no large oil content increase already from treatment 14 DAF, with the exception of hybrid NS-H-43 which evidently required a later treatment. Considering the time of treatment in relation to seed moisture, this hybrid achieved maximum oil content when treated at 31% seed moisture. In hybrid NS-H-26 RM, however, maximum oil content was achieved with treatment at 25% seed moisture.

Key words: sunflower, desiccation, oil content, moisture content

INTRODUCTION

Introduction of chemical desiccation had solved many problems associated with mechanized sunflower harvest. Advantages of this cultural practice were noted by numerous authors (Shadden *et al.*, 1970; Degtyarenko, 1976; Hill *et al.*, 1974). If chemical desiccation is performed in early stages of plant maturation, it may impair seed yield and quality. Late treatment brings in question the economic effects of the practice. Recommendations for desiccation time vary from 25% seed moisture (Palmer and Sanderson, 1976), 30-35% seed moisture (Degtyarenko, 1976; Kosovac and Sudimac, 1980), 40% seed moisture (Morozov, 1976; Gumanu-

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iuc *et al.*, 1980; Maširević and Glušac, 1999), 45% seed moisture (Gubbels and Dedio, 1985), to 35 day after drying of ray flowers (Dembiñski *et al.*, 1974).

Smirnova and Malyhin (1974) claimed that the treatment at 26-33% seed moisture increases the oil content by 1%, the treatment at 45-47% does not bring any difference in relation to the control, while the treatment at 56-58% may reduce the oil content up to 3%. Maximum oil contents were achieved with treatment or harvest at seed moistures of 30-35% (Popov and Proskurina, 1990), 48% (Baranova, 1968), 45% (Dedio, 1985), 50% (Gubbels and Dedio, 1985), 35-50% (Chervet and Vear, 1989), 60% (Role *et al.*, 1976; Rodrigues Pereira, 1978).

The objective of this study was to determine the optimum time of chemical desiccation in commercial seed production of sunflower hybrids, in order to maximize the economic effects of the production from the point of oil content in seed.

MATERIALS AND METHODS

Field trials were conducted in sunflower seed production fields in the course of 1994, 1995 and 1996. Each trial was established in three replicates, with the basic plot size of 17.5 m^2 (one row 25 m x 70 cm, one empty row between the treatments, to avoid drift effect).

Treatments were conducted at 7-day intervals starting from the end of pollination, *i.e.*, from the end of flowering. Reglone forte was used in the concentration of 1%, *i.e.*, the dose of 2 l/ha of the preparation was added to 200 liters of water/ha. This dose, but mixed with a larger amount of water, was recommended by Maširević and Glušac (1999). Treating was done with a portable sprayer.

The experimental material were female components of hybrids NS-H-45, NS-H-111, NS-H-26 RM and NS-H-43.

The end of pollination was defined as the end of pollination in the center of the head. Since the experiment was conducted in large seed production plots, average seed samples from entire heads were taken in order to make the results comparable. Seed moisture was determined by the classical method of drying at 105^oC till constant weight.

At full maturity, seed samples were taken in all treatments and the control for oil content determination. Oil content was determined by the method of nuclear magnetic resonance (NMR) and expressed in relative values.

The obtained results were statistically processed using the analysis of variance for two-factorial and three-factorial trials and the regression analysis.

RESULTS AND DISCUSSION

The values of seed moisture at the time of treatment varied in dependence of treatment variant, year and location (Table 1).

The highest oil content (45.98%) was registered in 1995, the lowest (45.60%) in 1996. The differences among the years were not significant (Table 2).

Table 1: Moisture content at the moment of desiccation (%)

Year Y	Hybrid H	Term of treatment T					x YH	x Y
		7 DAF	14 DAF	21 DAF	28 DAF	Check		
1994	NS-H-45	66.58	53.06	34.18	25.44	12.13	38.28	41.42
	NS-H-111	69.72	60.53	51.27	39.19	12.36	46.61	
	NS-H-26	59.71	47.57	31.59	18.28	12.43	33.92	
	NS-H-43	66.11	60.27	53.96	41.32	12.61	46.85	
	x YR	65.53	55.36	42.75	31.06	12.38		
1995	NS-H-45	71.87	59.18	55.42	38.96	13.39	47.76	40.62
	NS-H-111	67.06	52.06	39.50	22.18	12.20	38.60	
	NS-H-26	54.78	43.51	25.20	22.10	11.24	31.37	
	NS-H-43	68.24	57.13	49.27	35.96	13.15	44.75	
	x YR	65.49	52.97	42.35	29.80	12.50		
1996	NS-H-45	73.59	57.57	45.14	28.64	12.59	43.50	42.62
	NS-H-111	63.39	47.08	43.73	29.60	12.36	39.23	
	NS-H-26	58.92	49.28	41.32	22.40	8.36	36.06	
	NS-H-43	67.01	59.80	61.63	54.34	15.62	51.68	
	x YT	65.73	53.43	47.96	33.74	12.23	x H	
x HT	NS-H-45	70.68	56.60	44.91	31.01	12.70	43.18	
	NS-H-111	66.72	53.22	44.83	30.32	12.31	41.48	
	NS-H-26	57.80	46.79	32.70	20.93	10.68	33.78	
	NS-H-43	67.12	59.07	54.95	43.87	13.79	47.76	
x T		65.58	53.92	44.34	31.53	12.37		

LSD	1994			1995			1996		
	H	T	H x T	H	T	H x T	H	T	H x T
5%	2.11	2.36	4.71	2.79	3.12	6.24	2.50	2.80	5.60
1%	2.82	3.15	6.30	3.73	4.18	8.35	3.35	3.75	7.49

LSD	Y	H	T	Y x H	Y x T	H x T	Y x H x T
5%	1.22	1.40	1.57	2.43	2.72	3.14	5.44
1%	1.61	1.86	2.08	3.22	3.60	4.15	7.19

Hybrid NS-H-111 achieved the highest average oil content (51.06%), hybrid NS-H-45 the lowest (38.47%). The differences among al hybrids were highly significant.

The lowest oil content was registered in the first treatment (41.07%), the highest in the control (47.79%). There were no significant differences in oil content among 21 DAF, 28 DAF and the control, but 7 DAF and 14 DAF had significantly

lower contents. In other words, there were no further reductions in oil content after the treatment at seed moisture of 44.34%.

Table 2: Oil content (%)

Year Y	Hybrid H	Term of treatment T					x YH	x Y
		7 DAF	14 DAF	21 DAF	28 DAF	Check.		
1994	NS-H-45	36.33	38.84	39.41	39.37	39.52	38,69	45,93
	NS-H-111	43.83	51.07	51.34	52.46	52.17	50,17	
	NS-H-26	43.27	50.45	52.05	50.70	51.20	49,53	
	NS-H-43	38.87	41.85	49.71	47.01	49.13	45,31	
	x YT	40.57	45.55	48.13	47.38	48.00		
1995	NS-H-45	36.75	37.50	39.95	39.60	39.46	38,65	45,98
	NS-H-111	46.65	51.32	51.14	53.20	52.43	50,95	
	NS-H-26	43.04	51.24	52.10	50.71	50.97	49,61	
	NS-H-43	34.70	45.99	47.92	47.70	47.26	44,71	
	x YT	40.28	46.51	47.78	47.80	47.53		
1996	NS-H-45	35.40	37.72	38.61	39.76	38.84	38.06	45.60
	NS-H-111	49.38	52.42	50.77	53.84	53.86	52.05	
	NS-H-26	47.59	48.01	49.03	49.52	49.98	48.83	
	NS-H-43	37.06	42.50	42.90	46.11	48.62	43.44	
	x YT	42.36	45.16	45.32	47.31	47.83	x H	
x HT	NS-H-45	36.16	38.02	39.32	39.58	39.27	38.47	
	NS-H-111	46.62	51.61	51.08	53.17	52.82	51.06	
	NS-H-26	44.63	49.90	51.06	50.31	50.72	49.32	
	NS-H-43	36.88	43.45	46.84	46.94	48.34	44.49	
x T		41.07	45.74	47.08	47.50	47.79		

LSD	1994			1995			1996		
	H	T	H x T	H	T	H x T	H	T	H x T
5%	2.12	2.37	4.74	1.75	1.96	3.91	2.25	2.52	5.04
1%	2.84	3.17	6.34	2.34	2.62	5.23	3.02	3.37	6.75

LSD	Y	H	T	Y x H	Y x T	H x T	Y x H x T
5%	1.01	1.16	1.30	2.01	2.25	2.60	4.50
1%	1.33	1.53	1.72	2.66	2.97	3.43	5.94

Hybrids NS-H-45 and NS-H-43 had the highest average oil contents in the first year, the lowest in the third year. Conversely, hybrid NS-H-111 had the highest oil content in the third year and the lowest in the first year. Hybrid NS-H-26 RM had the highest oil content in the second year, the lowest in the third year. The differences among the years were not significant.

The first treatment had the highest oil content in the third year. Treatments 14 and 28 DAF had the highest oil content in the second year, treatment 21 DAF and the control in the first year. Significant differences were found only for treatment 21 DAF, between the contents in the first and the third year.

When averaged over all treatments, the highest oil content was found in hybrid NS-H-111, the lowest in NS-H-45. Significant differences existed among the hybrids in all treatments.

In hybrid NS-H-45, the highest oil content was found in treatment 28 DAF (39.58%), the lowest in treatment 7 DAF (36.16%). No significant differences could be found among treatments 14, 21 and 28 DAF and the control. Treatment 7 DAF had a significantly lower oil content than the last two treatments and the control.

In hybrid NS-H-111, the highest oil content was found in treatment 28 DAF (53.17%), the lowest in treatment 7 DAF (46.62%). No significant differences occurred between treatments 14, 21 and 28 DAF.

In hybrid NS-H-26 RM, the highest oil content was found in treatment 21 DAF (51.06%), and the significantly lowest content in treatment 7 DAF (47.59%). No significant differences occurred between treatments 14, 21 and 28 DAF and the control.

In hybrid NS-H-43, the highest oil content was found in the control (48.34%), the lowest in treatment 7 DAF (36.88%). There were no significant differences between treatments 21 and 28 DAF and the control, but these treatments were significantly different in relation to treatment 14 DAF, and highly significantly different in relation to treatment 7 DAF.

It was established that seed moisture at the time of desiccation had a high effect on oil content in all hybrids (Table 1). Coefficients of determination were high; the lowest was found for hybrid NS-H-26 RM ($r^2 = 0.69^{**}$), the highest for hybrid NS-H-43 ($r^2 = 0.84^{**}$). Regression curve indicated that the oil content in all hybrids increased as the seed moisture decreased. Maximum oil contents were reached at seed moistures of 25.12%, 26.26%, 28.84% and 30.80% in hybrids NS-H-26 RM, NS-H-111, NS-H-45 and NS-H-43, respectively (Figure 1).

The differences among the hybrids were significant and highly significant. The highest oil content was found in hybrid NS-H-111, the lowest in NS-H-45. The order of the hybrids did not change over the experiment years. Such results were expectable since they merely confirmed the results of previous long-term trials. The low oil content in the female component of hybrid NS-H-43 was not expected. This was evidently due to the slow maturation rate of this line, which was treated at higher seed moistures than the other hybrids.

The highest oil content was found in the control variant. The absence of significant differences among treatments 21 DAF, 28 DAF and the control indicated that there was no large increment in oil content in the period after the average seed moisture reached 44.34% and maturity.

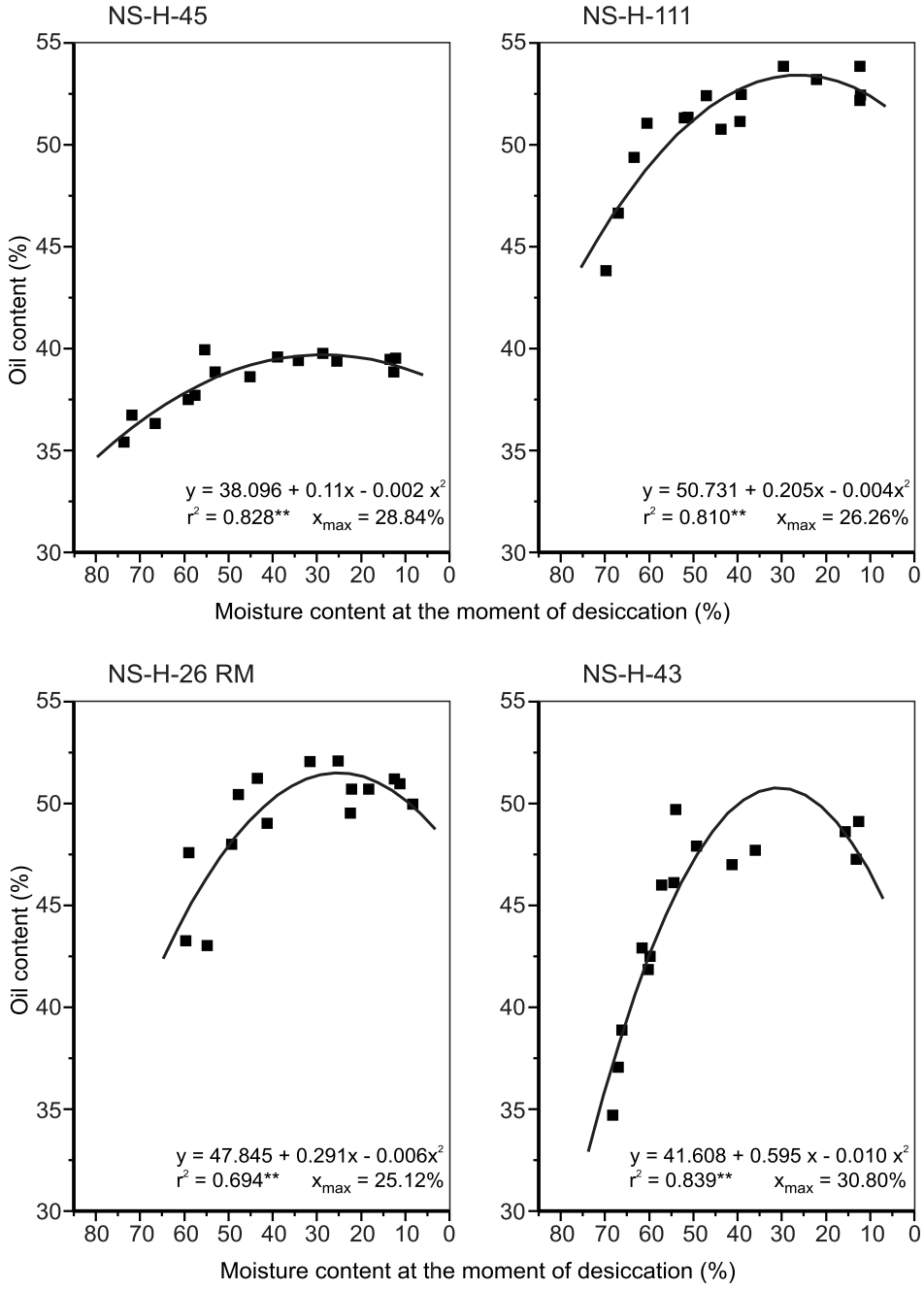

Figure 1: Effect of seed moisture at the moment of desiccation on oil content

Considering individual hybrids, there were no significant increments in oil content since treatment 14 DAF, except in hybrid NS-H-43. This hybrid is characterized by a slow maturation rate and a slow release of seed moisture. From the point of seed moisture at the moment of desiccation, this hybrid favors an early desiccation. In hybrid NS-H-26 RM, however, which has the fastest maturation rate, maximum oil content was achieved with desiccation at seed moisture of 25%.

Maximum oil contents are achieved with treatment or harvest at seed moistures of 30-35% (Popov and Proskurina, 1990), 48% (Baranova, 1968), 45% (Dedio, 1985), 50% (Gubbels and Dedio, 1985), 35-50% (Chervet and Vear, 1989), 60% (Role *et al.*, 1976; Rodrigues Pereira, 1978). Evidently, the results of our study are not in agreement with the results of all of these authors.

Our results are in good agreement with the results of Smirnova and Malyhin (1974) who found that the treatment at 26-33% seed moisture increased the oil content by 1%, the treatment at 45-47% did not bring any difference in relation to the control, while the treatment at 56-58% reduced the oil content up to 3%.

In most cases, there was a small decrease of oil content in the control compared with the optimum treatments. Hill *et al.* (1974) and Kosovac and Sudimac (1980) obtained similar results. Rodrigues Pereira (1978) attributes this decrease to oil transfer from the kernel to the husk and to the dissimilation of the accumulated oil after a steady supply of assimilates coming from the mother plant has been disrupted.

CONCLUSIONS

Following conclusion may be drawn on the effect of time of chemical desiccation on oil content in seed.

Annual variations in oil content were insignificant.

The differences among the hybrids were significant and highly significant. Hybrid NS-H-111 had the highest oil content, hybrid NS-H-45 the lowest.

The highest average oil content was found in the control. There were no large differences among treatments 21 DAF, 28 DAF and the control. It means that there was no large increment in oil content in the period after the average seed moisture reached 44.34% and maturity.

Considering the time of treatment, there were no significant increments in oil content since treatment 14 DAF, except in hybrid NS-H-43 which requires a later treatment.

Considering the seed moisture at the moment of desiccation, hybrid NS-H-43 achieved the maximum oil content with desiccation at seed moisture near 31%, whereas hybrid NS-H-26 RM achieved maximum oil content was with desiccation at seed moisture of 25%.

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EFECTO DEL TIEMPO DE DESECACION SOBRE EL CONTENIDO DE ACEITE EN DIVERSOS HIBRIDOS DEL GIRASOL

RESUMEN

La desecacion quimica por el preparado Reglone Forte fue investigada en cuatro hibridos del girasol en la produccion comercial. Reglone Forte (2 l/ha) era aplicado cada siete dias desde el fin de fecundacion hasta la madurez. La humedad de semillas fue determinada antes de cada tratamiento. El contenido de aceite en las semillas fue determinado en madurez, por el metodo de la resonancia magnetica nuclear. El mas grande contenido de aceite fue constatado en el control, el menos grande en el tratamiento durante siete dias despues de la florescencia. La ausencia de diferencias importantes entre los tratamientos durante 21 dias despues de la florescencia, 28 dias despues de la florescencia

y el control indican que no hay un grande aumento en del contenido de aceite en el periodo cuando la humedad media de semillas llego a 44,34% hasta la madurez. Con respecto a los hibridos particulares, no fue un grande aumento en el contenido de aceite ya desde el tratamiento de 14 dias despues de la florescencia, a excepcion del hibrido NS-H-43 que exige evidentemente un tratamiento mas tarde. En cuanto a la relacion entre el tiempo de tratamiento y el contenido de humedad en las semillas, este hibrido logro el contenido maximo de aceite cuando era tratado con la humedad de semillas de 31%. Entretanto, en caso del hibrido NS-H-26 RM, el contenido maximo de aceite fue realizado por el tratamiento con la humedad de semillas de 25%.

EFFET DU TEMPS DE DESSICCATION SUR LE CONTENU EN HUILE DANS DIFFÉRENTS HYBRIDES DE TOURNESOL

RÉSUME

La dessiccation chimique au moyen d'une préparation de Reglone Forte a été étudiée sur quatre hybrides de tournesol en production commerciale. Le Reglone Forte (2 1/ha) a été administré tous les sept jours depuis la fin de la pollinisation jusqu'à la maturité. L'humidité de la graine a été déterminée avant chaque traitement. Le contenu d'huile dans la graine a été établi à la maturité par la méthode de résonance magnétique nucléaire. Le contenu d'huile le plus important a été constaté dans le contrôle, et le contenu le moins important, dans les plantes traitées sept jours après la floraison. L'absence de différences significatives entre les traitements effectués 21 jours après la floraison, 28 jours après la floraison et les contrôles montre qu'il n'y a pas d'augmentation importante du contenu d'huile depuis la période où l'humidité moyenne de la graine atteint 44.34% jusqu'à la maturité. Si on considère les hybrides individuellement, il n'y a pas eu d'augmentation importante du contenu d'huile à partir du traitement effectué 14 jours après la floraison, sauf pour l'hybride NS-H-43 qui exige manifestement un traitement plus tardif. Pour ce qui concerne le temps du traitement par rapport à l'humidité de la graine, cet hybride a atteint le contenu maximal en huile quand il a été traité à une humidité de 31%. Cependant, dans le cas de l'hybride NS-H-26 RM, le contenu maximal a été atteint avec un traitement où l'humidité était de 25%.