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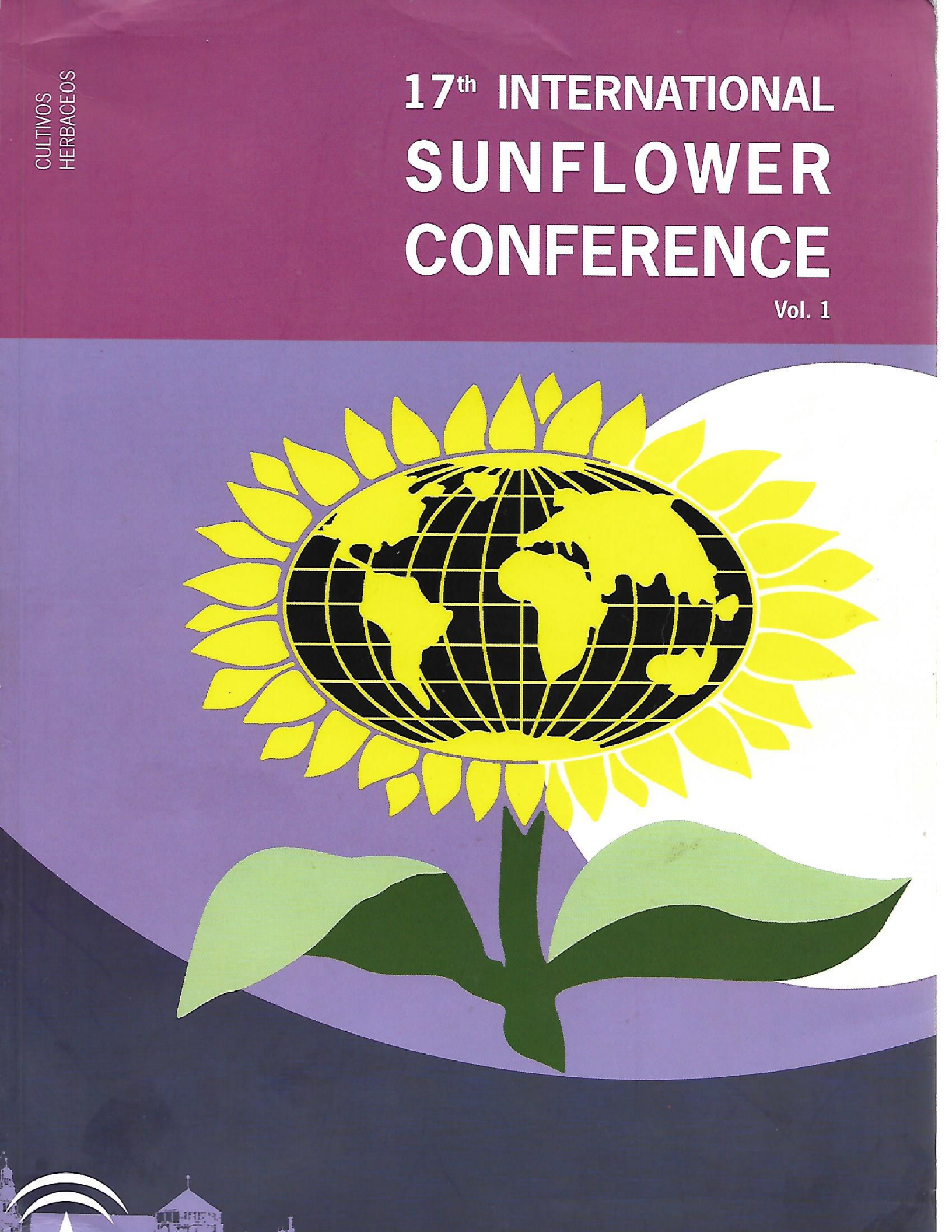

Proceedings of the

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Vol. 1

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JUNTA DE ANDALUCIA

Instituto de Investigación y Formación Agraria y Pesquera
CONSEJERÍA DE AGRICULTURA Y PESCA

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Photography: *Spanish landrace of confectionary sunflower collected by L. Velasco and B. Pérez-Vich in Villarta de San Juan, Ciudad Real, Spain, on October 10, 2007.*

Foreword

The proceedings of the *17th International Sunflower Conference* contain 142 contributions from scientists of 24 countries. They include plenary lectures in several disciplines and regular communications presented in posters during the conference and discussed in the corresponding workshops. The manuscripts are classified by disciplines. They offer a good picture of the current state of the art of sunflower research and cultivation around the world.

The manuscripts in the *Proceedings* have been reviewed by an editorial committee with the main objective of helping the authors to improve their manuscripts through a critical reading. The authors received the edited manuscripts together with the comments of the reviewers and then went on to draft their final version. All the manuscripts received have been published in the *Proceedings*. The contents of the manuscripts are the responsibility of the authors. They should be considered as being privileged communications that require the express consent of the authors to be reprinted in part or as a whole. We wish to thank both the members of the Editorial Committee for their dedication to the task of editing such a large number of manuscripts, as well as all the authors for their collaboration throughout the whole edition process.

The Organizing Committee would also like to thank Diana Badder and José A. Palacios for their excellent editorial assistance in the preparation of these *Proceedings*. We are indebted to the Spanish Association of Sunflower Breeders (Asociación Española de Mejoradores de Girasol), which collaborated actively in the organization of the conference, and, very especially, to Juan Parejo, who was in charge of the financial side.

Finally, we would like to thank all the participants in the conference, who have contributed to its success by a careful preparation and revision of manuscripts and posters, presentation of their research in the workshops, and stimulating discussions throughout the conference on the scientific and technical aspects of sunflower research and cultivation in the world.

The Organizing Committee
17th International Sunflower Conference
Córdoba, Spain. June 8-12, 2008

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PLENARY

DISEASE RESISTANCE AND PATHOLOGY

CROP PRODUCTION – PHYSIOLOGY

Changes in seed oil content of sunflower (*Helianthus annuus* L.) as affected by harvesting date

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ABSTRACT

The paper studied the effect of harvesting date on seed oil accumulation in three sunflower genotypes. Harvesting began seven days after pollination and continued at three to four day intervals until ten harvests were carried out in all. Parallel to this, seed moisture content was determined as well. The trial's locations were India and Serbia. In both locations, the genotypes ranked the same for oil content, but all three produced considerably higher values in Serbia. The trial locations differed as to how the minimum and maximum air temperatures fluctuated in them. Regression analysis revealed that in all three genotypes in both locations the highest oil contents were produced with seed moisture at harvesting at around 30%.

Key words: air temperature – moisture content – oil content – sunflower.

INTRODUCTION

Oil is the main reserve substance in sunflower seeds. Seed oil accumulation begins relatively early, several days after pollination, as soon as the space for oil storage forms. Seed oil percentage depends more on weather conditions in the first part of the seed filling stage, while absolute seed weight depends more on the conditions in the second. Higher temperatures in the early stages of seed fill lead to a higher seed oil content (Škorić et al., 1988). The question is, when does oil accumulation end? This is important because of the need for an earlier harvest, especially when chemical desiccation of sunflower is planned. The moment when seed oil content peaks could be expresseed as days after the end of pollination, but the length of this period depends greatly on weather conditions. In Russia, for example, seed oil content may reach its peak anywhere between 30 and 60 days after flowering (Šepetina and Rogoževa, 1971). Seed moisture content is a better indicator of the maximum oil content. Depending on the author, peak seed oil levels are achieved when seed moisture is at 60% (Role et al., 1976), 45% (Dedio, 1985), 33-50% (Chervet and Vear, 1989), 26-30% (Miklič, 2001), etc. Such diverse findings may be a result of differences in weather conditions or of different genotypes used in the trials.

The objective of this paper was to determine how the same set of sunflower genotypes behaves in different agroecological conditions with respect to oil accumulation rate.

MATERIALS AND METHODS

The trial was first carried out in India (Hyderabad, Andra Pradesh) in 1999 and then in Serbia (Rimski Šančevi) the following year. The usual crop tending measures were applied and a randomized block design with three replications was used. The following sunflower genotypes were studied:

1. Ha-Ns-26
2. Ocms-98
3. Ocms-74

The harvesting of sunflower heads began seven days after the end of flowering and continued therafter at three to four day intervals until a total of ten harvesting dates was reached. Three heads were taken from each replicate. The seed moisture content was determined right after harvesting using the common method of drying the seed in a dryer at 105°C to a constant weight. The seed oil content was expressed in relative terms and was determined by leaving the seed to dry naturally and then using nuclear magnetic resonance (NMR) to measure oil levels. Data on the minimum and maximum daily air temperatures during ripening were taken from the local weather stations.

Data were processed with the MSTATC statistical package and the results were interpreted using two-factor ANOVA and regression analysis.

RESULTS AND DISCUSSION

In India, the Ocms-98 genotype had the highest and Ocms-74 the lowest average seed oil content (Table 1). Differences between the genotypes were highly significant. The highest average oil content was recorded on the last harvesting date, with an average seed moisture (ASM) of 10.75%. From the sixth harvesting date on (at 43.27% ASM), there was no significant increase in seed oil content observed.

Table 1. Seed oil content (%) as affected by harvesting date in three sunflower genotypes in India

Genotype	Harvesting date										Average
	1	2	3	4	5	6	7	8	9	10	
Ha-Ns-26	6.9	15.0	29.1	34.5	36.9	37.3	36.3	36.8	35.7	37.3	30.6
Ocms-98	13.3	22.8	31.4	40.0	38.0	37.8	39.9	38.0	38.1	37.1	33.6
Ocms-74	5.5	1.4	4.7	24.5	20.9	28.5	31.8	33.5	34.1	35.8	22.1
Average	8.5	13.1	21.7	33.0	31.9	34.6	36.0	36.1	36.0	36.7	28.8

LSD	Genotype	Harvesting date	Genotype x Date
5%	1.68	3.08	5.33
1%	2.24	4.09	7.09

The Ha-26 genotype had the highest oil contents on the sixth and tenth harvesting dates (at 34.66 and 11.00% ASM), although from the fourth date (52.14% ASM) onwards, there was no statistically significant increase in the oil content. In Ocms-98, the highest seed oil content was found on the fourth harvesting date (51.14% ASM) and there were no significant changes in this parameter from then on. In Ocms-74, the highest seed oil content was observed on the tenth harvesting date (10.27% ASM), with no significant increases from the seventh date (41.00% ASM) onward.

In Serbia, the highest average seed oil content was found in Ocms-98 and the lowest in Ocms-74 (Table 2). Differences between the genotypes were either significant or highly significant. The highest average seed oil content was recorded on the ninth harvesting date (at 19.18% ASM). From the fourth date (50.11% ASM) forth, the value of this parameter did not increase significantly.

Table 2. Seed oil content (%) as affected by harvesting date in three sunflower genotypes in Serbia

Genotype	Harvesting date										Average
	1	2	3	4	5	6	7	8	9	10	
Ha-Ns-26	32.5	34.9	40.2	37.6	36.1	40.5	37.9	36.5	44.9	46.4	38.8
Ocms-98	29.6	33.8	41.1	43.5	51.2	51.4	48.1	52.6	50.8	50.2	45.2
Ocms-74	15.6	28.3	32.9	39.8	40.9	39.4	41.2	40.6	44.0	41.8	36.5
Average	25.9	32.3	38.1	40.3	42.7	43.8	42.4	43.2	46.6	46.1	40.2

LSD	Genotype	Harvesting date	Genotype x Date
5%	1.85	3.38	5.85
1%	2.46	4.49	7.78

The highest seed oil content of Ha-Ns-26 was achieved on the tenth harvesting date (8.87% ASM), with no significant increase being recorded after the ninth date (12.45% ASM). In Ocms-98, the highest oil content was recorded on the eighth date (33.61% ASM), and there was no significant increase in this parameter from the fifth date (54.59% ASM) on. Ocms-74 had the highest oil content on the ninth harvesting date (22.93% ASM) and no significant increase after the fourth date (50.10% ASM).

A strong relationship between seed moisture content and seed oil content at harvesting was found. The regression curves below show increasing oil content with decreasing seed moisture. In most cases, maximum oil levels were achieved with seed moisture at about 30% (at any time the coefficient of determination was around 0.9 or higher) (Fig. 1.). The coefficients of determination were high, ranging from 0.62 to 0.96.

Minimum and maximum daily temperatures at ripening varied a lot between the two locations (Fig. 2).

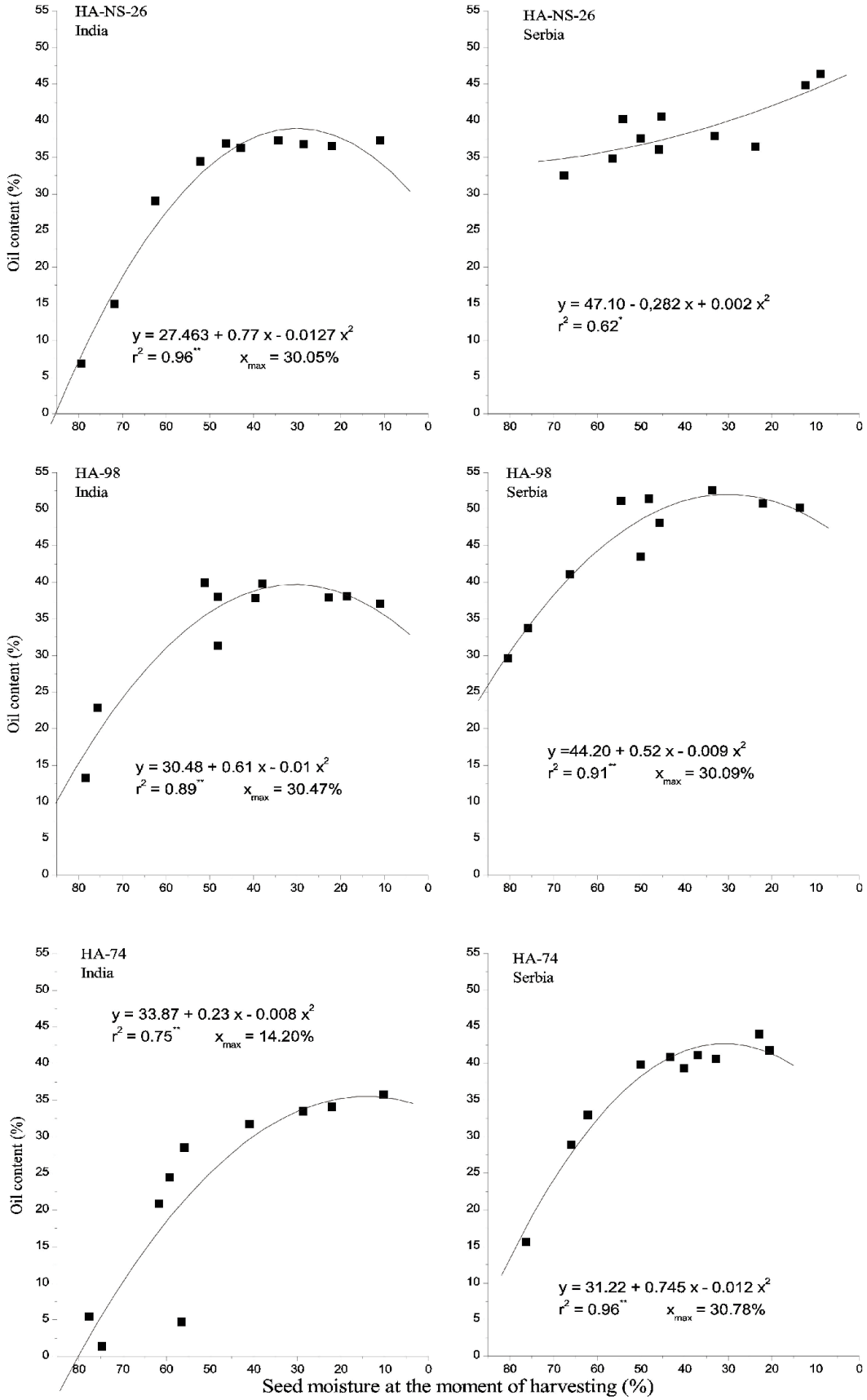

Fig. 1. Seed oil content as affected by seed moisture content at harvesting

Minimum and maximum temperatures varied a lot less in India than in Serbia. In India, the maximum temperatures were initially below 30°C and then they kept increasing slightly for much of the rest of the season, whereas the minimum temperatures increased steadily and significantly from the beginning. In Serbia, the maximum and minimum temperatures were considerably higher in the early stages of ripening, after which they kept decreasing steadily, albeit with large fluctuations. There was no significant precipitation in either location during the period. Day length was considerably greater in Serbia.

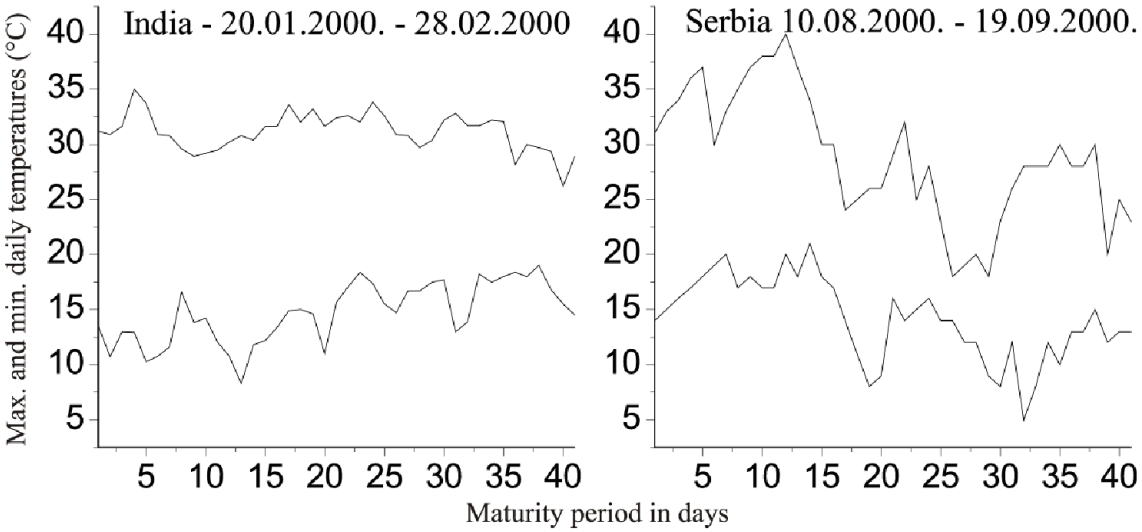

Fig. 2. Minimum and maximum temperatures during maturation

In both locations, therefore, the maximum oil content was reached with seed moisture at about 30%, which is in agreement with the results of Miklič (2001). In most cases, however, statistically significant increases in oil content were already absent with seed moisture at around 50%, which is in agreement with the findings of Chervet and Vear (1989). Considerably higher oil contents were obtained in Serbia than in India. Given that the same set of genotypes was used in both locations, this could be attributed to weather conditions. In Serbia, these conditions were better suited to producing higher oil levels, because minimum and maximum air temperatures at seed fill were higher than in India. Higher temperatures in the first part of the seed filling stage will result in a higher oil content (Škorić et al., 1988). In some cases, minor drops in seed oil content were observed in the closing days of maturation. Rodrigues Pereira (1978) attributes this to the transfer of oil from the kernel to the husk and to dissimilation of accumulated reserves in the absence of inflowing assimilates once the connection between seed and the mother plant has ceased.

CONCLUSIONS

The Ocms-98 genotype had the highest oil content in both locations.

The highest average oil content at both sites was recorded on late harvesting dates, but in most cases no significant differences were recorded once the seed moisture content dropped down to 50% or thereabouts.

Regression analysis showed that in the majority of cases the oil content reached its theoretical maximum with a seed moisture level of 30%.

Considerably higher oil levels were achieved in Serbia than in India, most likely as a result of the more favorable weather conditions in the former.

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