T1980AGRO43

DATE OF PLANTING AND PLANT POPULATION - IMPORTANT FACTORS IN INCREASING SUNFLOWER SEED AND OIL YIELDS

H. NICOLAE, G. SIN, N. GUMANIUC, H. FILIPESCU and I.

INTRODUCTION

Planting is a significant event for sunflower crop technology. Besides a proper soil preparation, planting time and the density of the plants should be properly chosen as they are important factors in the future development of the plants.

The introduction of sunflower hybrids whose agrobiological features differ from those of ancient varieties required studies on their technology.

Previous romanian studies concerning the specific requirements of sunflower varieties (Sipos and al., 1962; Scurtu and al., 1964; Sarpe and al., 1965) as well as other recent works (Sin, 1970; Vranceanu and al., 1974; Cseresnyes, 1975; Sin and al., 1978; Nicolae and al., 1979) pointed out the importance of some factors in obtaining good sunflower yields.

The results of foreign studies emphasized the role of planting time and of the density of plants in increasing sunflower seed and oil yields under different pedoclimatic conditions (Robinson, 1970; Johnson et al., 1972; Lopez, 1974; Keefer et al., 1976; Alessi et al., 1977; Jones, 1978).

There are significant differences between varieties and hybrids concerning planting time and optimum density of plants. These differences are determined by the nature of the variety or by the hybrid seed characteristics (husk tickness, oil content, etc.) and by plant habitus, climatic conditions, soil fertility and the condition of the seed-bed.

* Research Institute for Lareals and Industrial Plants. Fundulea, Rumania.

The present paper shows some results regarding the influence of planting time and plant density on seed and oil yield level and quality from experiments conducted at Fundulea in the past seven years, using some varieties and hybrids registered in Romania.

MATERIALS AND METHODS

The experiment was conducted at the Research Institute for Cereals and Industrial Crops —Fundulea, on moderate leached chernozem during the period 1973-1979. The precursory crop was wheat, the annual fertilization $N_{90}P_{60}$. The distance between rows was 70 cm and planting depth 5-6 cm. One variety and seven hybrids were investigated.

The first planting date was chosen according to the first possible date for mechanical planting, the others followed at two weeks intervals.

As far as the density of plants is concerned, we studied densities of 30, 40, 50 and 60 thousand plants per ha. In 1973-1979 period we studied three varieties and seven hybrids.

Oil content was determined by nuclear magnetic resonance, and fatty acid composition of the oil by gas-liquid chromatography of methyl esters.

RESULTS AND DISCUSSION

1. The influence of planting time

The optimum time for sunflower planting at Fundulea proved to be between the 1st and the 15th of April, when we obtained the highest seed yields (Fig. 1). When planting time was one to two weeks earlier or later than this time, we recorded a slight decrease of seed yields. The lowest yields were obtained whe planting time was at the first half of May.

The varieties and hybrids used in the experiment required different planting moments. Thus Sorem 80 was less influenced by the planting time, significantly equal seed yields being obtained for the first three planting periods. However, significantly lower seed yields were obtained in the case of the late planting, in May.

Oil yield has the same characteristics as that of the seed, late planting in May reducing the yield by 2,5 q of oil per ha.

Oil content was higher at earlier dates of planting, tending to decrease with the delay in planting. The decrease of the oil content (2-3% oil) was recorded as a reciprocal effect between vegetative stages and climatic conditions. At later dates of planting, the development of the plants was affected by higher temperatures and drought periods, so that the lenght of vegetation was reduced with more than 20 days. The oil content was negatively correlated with the daily mean temperature during the flowering to maturity stage ($r = -0,71^{xxx}$) and positively correlated with the number of days throughout the periods of emergence to maturity ($r \quad 0,56^{xxx}$), and flowering to maturity ($r \quad 0,50^{xx}$). A similar trend in the change of sunflower seed oil content was reported by many other authors, though sometimes more dramatic changes were reported comparing with our present results (Alessi, Power et al., 1977; Jones, 1978). The adverse effect of high daily temperature during the active seedfilling phase, as well as the negative association between oil accumulation and the rate of plant development described here, were confirmed and better established in controlled environmental conditions (McWilliam, Harris et al., 1976; Vrebalov, 1978).

The biological quality of the oil, in terms of linoleic acid content —considered today as an essential fatty acid—, exhibited a progressive increase with the delay in planting time (Tab. I). This was probably due to the fact that in the case of late planting the seed ripeness phase is prolonged through the end of August to the beginning of September, when daily temperatures were lower. The linoleic acid content was negatively correlated ($r \quad -0,56^{xxx}$) with the cumulative degrees of daily temperatures during flowering to maturity period. This enhance of linoleic acid biosynthesis at lower daily temperatures was reported by other authors (Schuster, Marquard et al., 1972; Johnson and Jellum, 1972; Keefer, McAllister et al., 1976) and biochemically explained (Popov, 1973; Dompert, Beringer et al., 1975; McWilliam, Harris et al., 1976).

For sunflower crop technology the length of the time between planting and emergence is of great importance. The number of days necessary for emergence is dependent on the temperature of the soil at the respective planting depth as well as on the levels of available humidity. The humidity of the soil in the proper areas for sunflower crop of Romania is usually insured, and only seldom humidity is not secured and results in non uniform crops and poor plant densities. The emergence usually requires 15 to 20 days, on condition that soil mean temperature at 5 cm depth is 10-12° C. For soil temperature of

above 17° C and optimum humidity, six days are usually enough for emergence, but as the temperatures are lower than 10° C, the lenght of emergence period increases accordingly.

TABLE I

Sunflower seed oil content and linoleic acid content at seed maturity for different dates of seeding in relation with the characteristics of the "flowering-maturity" stage.
Hybrid Sorem 80; means of years 1977-1979

Date of seeding	Seed oil content %	Linoleic content %	Flowering to maturity		
			Number of days	Daily mean temperature °C	Cumulative degrees of daily temperatures, °C
18-31.03	48,7	64,9	54	20,6	1112,4
1 -15.04	48,3	66,6	50	20,7	1028,8
15-30.04	47,8	66,2	49	20,7	1014,3
1 -15.05	46,5	68,4	49	20,0	985,0

Correlations

Seed oil content, with

— daily mean temperature of "flowering to maturity" ..... —0,71^{xxx}
— Number of days "seeding to maturity" ..... —0,56^{xxx}
— Number of days "flowering to maturity" ..... —0,50^{xx}

Linoleic acid content of the oil, with

— Cumulative degrees of daily temperatures during "flowering to maturity —0,56xxx

Later planting provides rapider plant emergence and shorter growing phases under higher temperature conditions. However, in Romania, sunflower fields planted late in May do not have as much heat as those of planted earlier. The harvesting time is different even in the case of the same hybrid (Fig. 3). This fact is due to different periods of time between planting and emergence as well as to growth phases, which are differently influenced by daily lower temperatures in the case of earlier planting and higher ones in the case of later planting. The daily temperature mean during planting to maturity periods for earlier and later dates of planting was 17° C and 19° C, respectively. Although the difference was only of 2° C, its effect was considerable and resulted in shortening the period from planting to maturity, by 156 to 121 days.

2. The effect of plant density

The levels of both seed and oil yields largely depended on the density of the plants (Fig. 4). Maximum yield was obtained at the density of 40.000 plants per ha, with slight differences for particular hybrids and varieties. Decrease or increase of plant density resulted in lower yields. At higher plant densities lodging was generally higher, with negative effects on mechanized harvesting.

In the case of higher densities, the oil yield decreased slighter than the seed yield. This phenomenon was possible because a small increase of oil content is associated with higher plant density, thus reducing the negative effect of lower seed yields.

SUMMARY

The paper presents research results obtained during 1973-1979 on moderately leached chernozem from Fundulea. There were studied one variety and four hybrids sowed at four dates (first day in spring, when is possible to manage the field, after that at 12-14 days intervals) so from the last decade of March to first ten days of May. Referring to plant population the studies were carried out with three varieties and seven hybrids, planted by 30, 40, 50 and 60 thousand plants/ha. The distance between the rows was 70 cm. Maximum seed and oil yields and the best oil quality have been obtained with the planting performed in periods when 10° C was recorded at sowing depth (so at the second date of planting). Optimum planting populations ranged from 40 to 45 thousand plants/ha and depended slightly on varieties and hybrids and climatic conditions encountered in the time of experiment.

REFERENCES

ALESSI J., POWER J. F., et al., 1977. Sunflower yield and water use as influenced by planting date population and row spacing. Agronomy J., *69, 3, p. 465.*

CSERESNYES ZOIA, 1975. Studiul indicilor calitativi ai semintelor de floarea-soarelui cu conţinut ridicat de ulei, în condiţii suboptime. Analele I.C.C.P.T., *42*, p. 103.

DOMPERT W., BERINGER H., et al., 1975. Linolsäure- und Tokopherolgehalt

von Sonnenblumenfrüchten in Abhängigkeit von Sorte und Standort. Z. Pfl. Ernärh. Düng. Bodenk., *138*, p. 141.

JOHNSON B. J. and JELLUM M. D., 1972. Effect of planting date on sunflower yield, oil and plant characteristics. Agronomy J., *64*, p. 747.

JONES R. O., 1978, Management practices for dryland sunflower in the U.S. southern Great Plains. Proceed. 8th Intern. Sunflower Conference, Minneapolis, Minnesota, U.S.A.

KEEFER G. D., MCALLISTER J. E. et al., 1976, Time-planting effects on development, yield and oil quality of irrigated sunflower. Austral. J. exper. Agric. Husb., *16*, p. 417.

LOPEZ LEÓN M., 1974, Effects of date of seeding of sunflower in irrigated plots on seed yield and oil content. Proceed. 6th Intern. Sunflower Conference, Bucharest, Romania, p. 559.

NICOLAE H. et al., 1979, Influenţa epocii şi densitaţii de semanat asupra producţiei de seminţe la floarea-soarelui. Producţia Vegetala - Cereale şi Plante tehnice, 3, p. 26.

POPOV P. S., 1973, O sutocinom hode biosinteza jira i otdelnîh jirnîh kislot v semenah podsolnecinika. Fiziol. Rast., *20*, p. 900.

ROBINSON R. G., 1970, Sunflower date of planting and chemical composition at various growth stages. Agronomy J., *62*, p. 665.

SCHUSTER W., MARQUARD R., et al., 1972, Der Einfluss der Umwelt auf Fettgehalt und Gettsäuremuster verschiedener Sonnenblumensorten. Fette, Seifen, Anstrichmittel, *74*, p. 150.

SARPE N., LUNGU I., et al., 1965. Influenţa desitaţii, agrofondului şi epocii de semanat asupra producţiei de floarea-soarelui. Analele I.C.C.P.T., *33*, p. 487.

SCURTU D., OLTEANU FLORICA et al., 1964, Influenţa condiţiilor climatice asupra germinarii şi rasaririi plantelor de in, floarea soarelui, fasole şi soia. Analele I.C.C.P.T., *32*, ser. B, p. 239.

SIN GH., 1970. Masuri agrofitotehnice hotarîtoare în sporirea producţiei de floarea-soarelui. Probleme Agricole, 2, p. 41.

SIN GH., PINTILIE C., NICOLAE H., et al., 1978. Influenţa densitaţii şi spocii de semanat asupra producţiei la floarea-soarelui. Analele I.C.C.P.T., *43*, p. 311.

SIPOS GH. and TIMIRGAZIU C., 1962, Rezultate experimentale privind densitatea optima a plantelor şi distanţa între rînduri la floarea soarelui pe cernoziomul din Banat. Probleme Agricole, 3, p. 28.

VRÂNCEANU V. A., 1974, Floarea-soarelui, Ed. Academiei R.S.R.

VREBALOV T., 1978. Effect of climatic factors - air, temperature and humidity on biological characters of sunflower. Proceed. 8th Intern. Sunflower Conference, Minneapolis, Minnesota, U.S.A.

WILLIAM MC J. R., HARRIS H. C., et al., 1976. Influence of temperature on the oil content and composition of sunflower. Proceed. 7th Intern. Sunflower Conference, Krasnodar, U.R.S.S., vol. II, p. 448-.

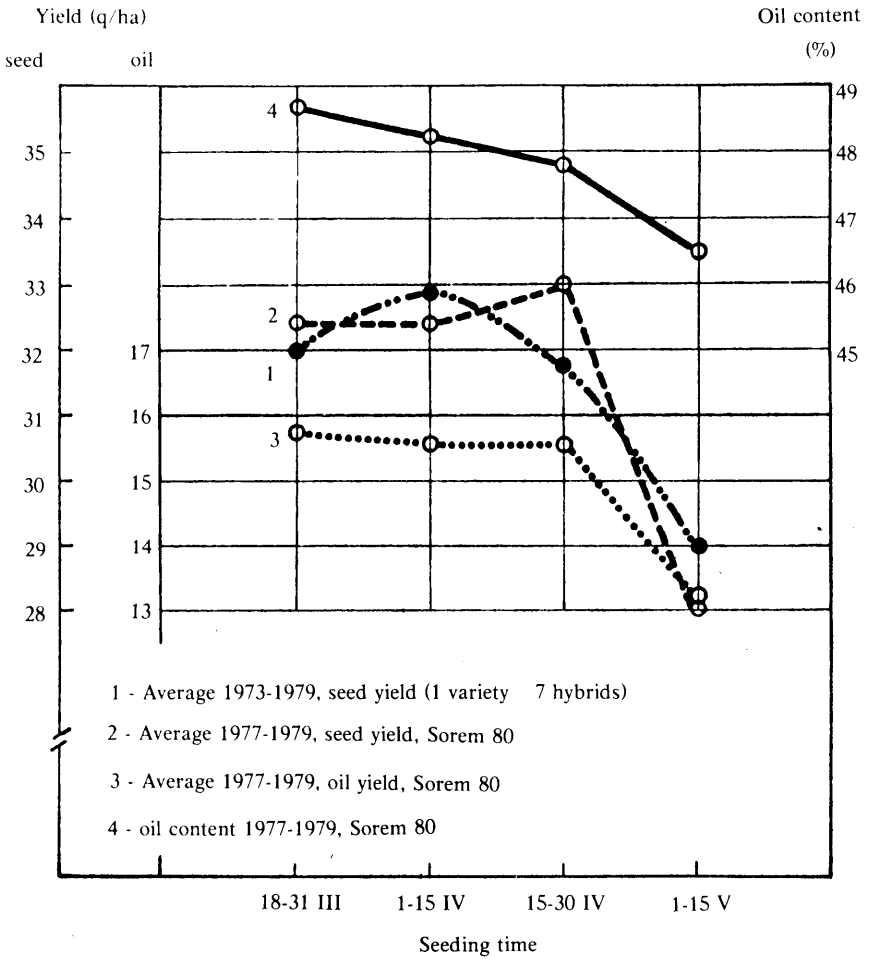

Fig. 1.—The effect of the seeding time on seed and oil productions for sunflower cultivated on moderate leached chernozem. Fundulea, years 1975-1979.

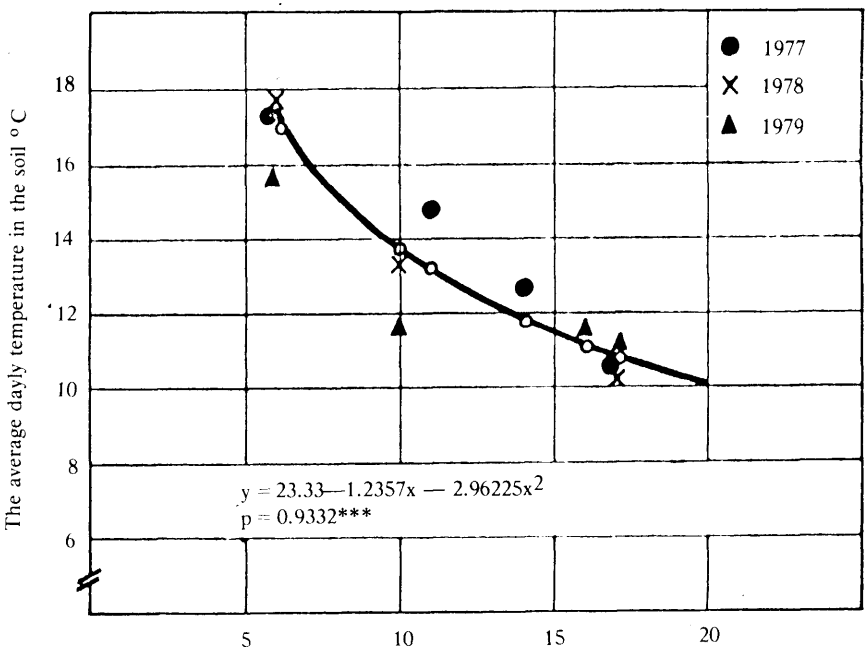

Fig. 2.— The relation between the soil temperature (at 5 cm depth) and the number of days from seeding to emergence. Sunflower hybrid SOREM 80; Fundulea, years 1977-1979. 18

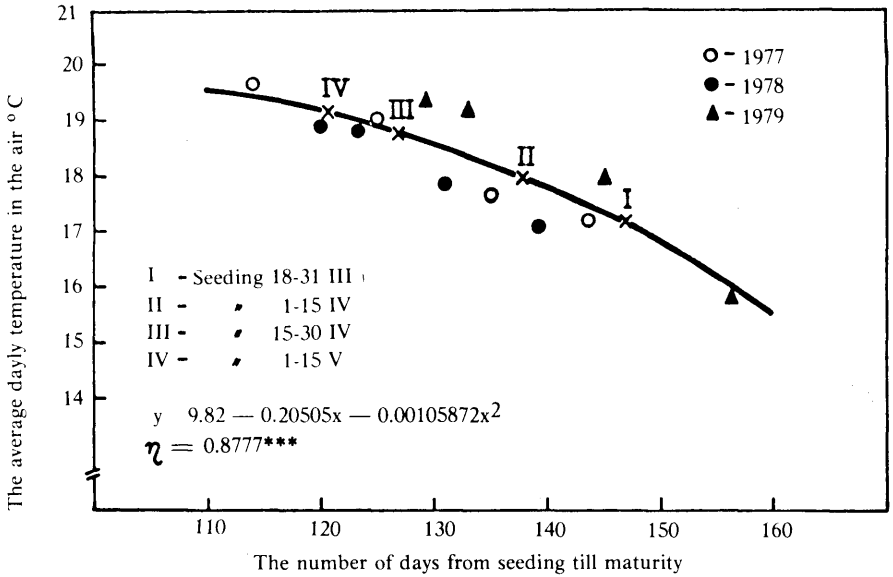

Fig. 3.— The relation between the daily mean temperature and the number of days from seeding to maturity.

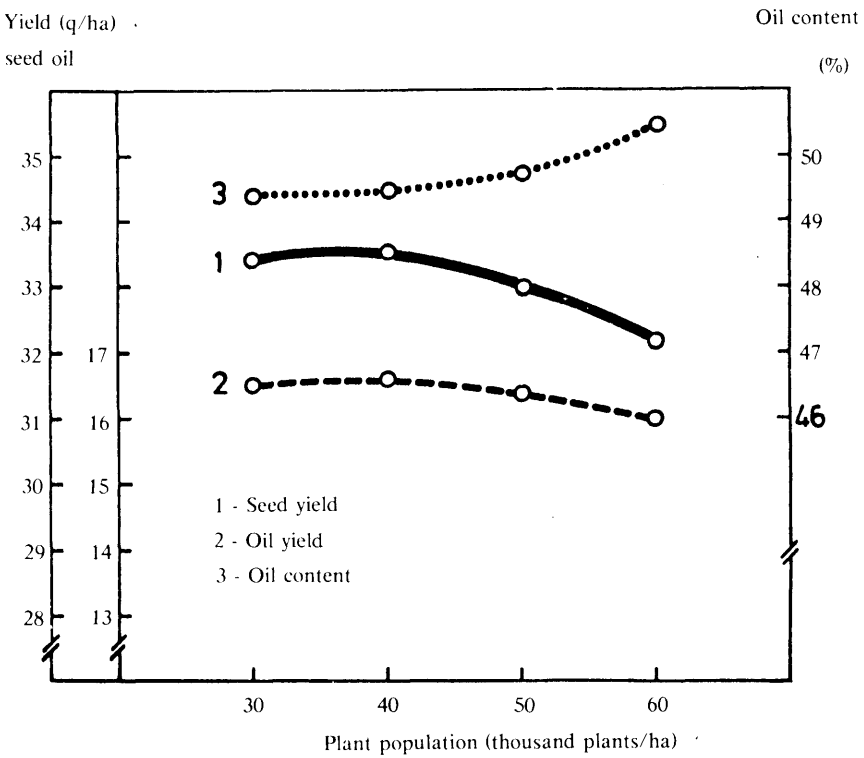

Fig. 4.— The effect of plant population on the seed and oil productions for sunflower cultivated on moderate leached chernozem. Fundulea, years 1975-1979.