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Oil Yield and Fatty Acid Composition of Spring Sunflower

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Abstract: Five sunflower hybrids were grown at four sowing dates to have variable maturity temperatures. The hybrids having the same oil yield potential may differ for the oil quality. Oil yield and oleic acid increased while linoleic acid decreased with increasing maturity temperature. The intersection point of oil yield and linoleic acid lines at 2000 growing degree days (GDD) may be the best compromise for high oil yield with the best quality.

Key words: Fatty acids, growing degree days, maturity temperature

Introduction

Sunflower, soybean and canola are non-traditional oilseed crops. Seed or parent material of non-traditional oilseed crops imported from different countries is tested for its adaptation and performance under local conditions and then released for cultivation. Being a non-traditional oilseed crop, sunflower cultivars are imported, tested and recommended for cultivation. Though yield and adaptability tests are conducted throughout the country yet quality of the produce has not been given due consideration.

Edible oils have two types of fatty acids i.e. saturated and unsaturated. Unsaturated fatty acids are further divided into monounsaturated and polyunsaturated fatty acids. Saturated fatty acids in sunflower include palmatic and stearic acids while unsaturated fatty acids are oleic and linoleic acids. Quality of sunflower oil is generally associated with the relative concentration of oleic and linoleic acids. Sunflower oil contains about 85-90% unsaturated fatty acids and 10-15% saturated fatty acids (Unger and Thompson, 1982). Oil containing higher percentage of unsaturated fatty acid is nutritionally better while the oil containing the higher percentage of polyunsaturated fatty acid is considered even better (Inberg and Johnston, 1990).

Temperature and solar radiation are considered to influence the seed yield and quality. Higher oil concentration at higher temperature has been reported by Jones (1984) while Harris *et al.* (1978) reported opposite results. However, Anderson *et al.* (1978) concluded that oil concentration is controlled by a complex set of factors including temperature particularly during seed development and maturation. Composition of fatty acids in oil is also closely related to temperature. Positive correlation of oleic acid and negative correlation of linoleic acid with temperature have been reported by Ugner (1982) while Unger and Thompson (1982) established that oleic and linoleic acid concentrations are related to solar radiation and day length.

The present study was aimed to assess the differences in oil contents and quality of some commonly grown sunflower hybrids matured under different temperature regimes.

Material and Methods

Five sunflower hybrids (Tarnab-714, Hysun-33, SF-187, SF-177 and Parsan-1) were planted on four dates (2, 9, 16 and 20th March) as the rains permitted at the University of Arid Agriculture, Rawalpindi during 1998. The experiment was laid out in Completely Randomized Block design with three replications . A plot size of 5x3.5 m^2 was maintained with 75 cm row to row and 25 cm plant to plant distance. Recommended dose of fertilizer (50:20:20 kg/ha NPK) was incorporated at the time of seedbed preparation. Sunflower seeds were planted with the help of dibbler putting three seeds per hill. After emergence, one plant per hill was maintained. All the other cultural practices were kept normal according to recommendations. Growing degree days from sowing to harvesting were calculated for all the sowings following the method described by Dwyer and Steward (1986).

Two central rows from each plot were harvested 40 days after the completion of flowering. Harvested plant heads were sun-dried for fifteen days and then threshed manually. Seeds were oven-dried for 48 hours. Oil contents were measured with NMR analyzer and fatty acids by Shimadzo gas liquid chromatograph(GLC), model GC-9 A-A.

Results and Discussion

The crop planted at different time took variable length of time to mature. The daily temperatures kept on rising gradually during the crop period. Length of maturity time and rising temperature affected the total growing degree days from sowing to maturity which were calculated to be 1947, 2156, 2364 and 2447 for the four sowing dates respectively. The pattern of growing degree days accumulation, from sowing to maturity, as it relates to yield and quality of oil has confirmed the previous postulation by Unger (1986).

Oil content from 9th March sowing was the highest (44.13%) which was at par with both the later sowings but significantly better than earlier sowing of 2nd March (Table 1). Oil content increased when sowing was done on 9th March but again decreased with further delay to 16th and 20th March but this decrease was statistically non-significant. The average temperature during flowering to harvesting period of first sowing (2nd March) was 29.5°C while for 9th March sowing it averaged to 31.5°C. The rise in temperature may be the cause of higher oil content from second sowing. Higher oil concentration at higher temperature have been reported by Johson and Jellum (1972). The temperature variation among the 9th March, 16th March and 20th March sowings was very small (with in 0.5°C) which explained the non-significant differences for oil content among these sowings. Anyhow these sowings had a difference of 300 GDD which could not make any difference as for as oil content is concerned. There may be a certain level of heat accumulation to which the increase is translated into oil content increase. This limit may be around 2000 GDD. Non-significant differences in oil contents among the hybrids depicted that these

Table 1: Oil contents (%) and fatty acid (%) composition of different sunflower hybrids affected by sowing time

Treatments	Oil contents	Stearic acid	Oleic acid	Linoleic acid
2nd March	34.93	6.05	54.19	39.69
9th March	44.13	5.62	58.73	35.59
16th March	43.08	5.62	60.01	34.32
20th March	43.02	5.58	60.51	33.84
LSD	6.217	0.373	2.841	2.684
Tarnab-714	40.97	5.64	58.01	36.42
Hysun-33	41.07	5.58	62.47	31.86
SF-187	41.59	5.88	53.12	40.98
SF-177	42.89	5.71	57.55	36.66
Parsan-1	39.94	5.89	60.66	33.39
LSD	ns	ns	3.177	3.001

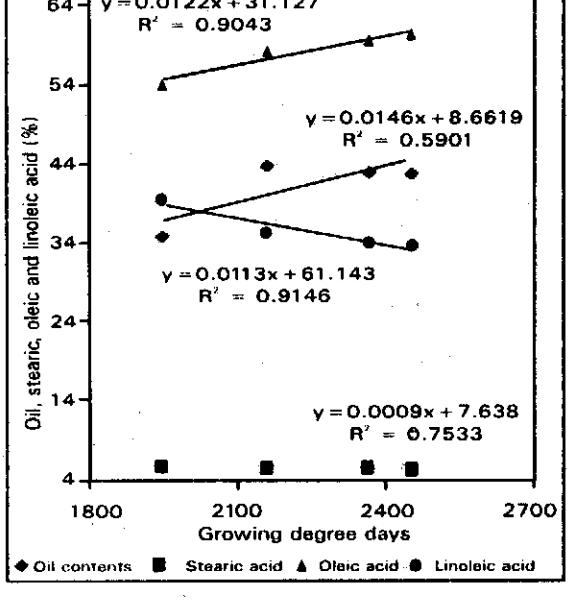

Fig. 1: Oil contents, stearic, oleic and linoleic acid and growing degree days relationship

hybrids had almost similar genetic potential for oil content. Stearic acid is categorized as saturated fatty acid and is an undesirable oil quality parameter. The highest concentration of stearic acid was obtained from 2nd March sowing which was significantly greater than rest of the sowings which were at par with one another (Table 1).

The pattern of stearic acid accumulation with respect to temperature and GDD depicted that lower temperature and lesser growing degree days favor the higher stearic acid accumulation. Knowles (1970) found higher concentration (13%) of stearic acid in central plateau of Mexico and lower concentration (9%) in California where temperature range was lower in Mexico and higher in California. Non-significant differences for stearic acid among the hybrids showed the genetic homogeneity.

Oleic acid is a monounsaturated fatty acid which is considered desirable for health. It increased progressively as sowing was delayed from 2nd March to 20th March. The lowest concentration of oleic acid was obtained from 2nd March sowing which increased significantly with later sowings (Table 1). The differences among later three sowing were non-significant. Progressive increase in oleic acid concentration and significant positive correlation with increasing degree days (Fig. 1) confirmed the earlie findings of Unger (1982) that sunflower maturation durin higher temperature yields oil with higher oleic aci concentration. Significant differences among the hybrid revealed that the genotypes having the same oil yiel potential may differ for the oil quality.

Linoleic acid is a polyunsaturated fatty acid whic determines the overall quality of oil. Higher percentage o linoleic acid means better quality oil. The highes percentage (39.69) of linoleic acid was obtained from 2n March sowing and it decreased significantly when sowin was delayed from 2nd March to 9th March and beyon (Table 1). The differences among the 9th March to 20t March sowings were statistically non-significant. Th differences may be attributed to the prevailing temperatur during the growth period. The progressive decrease i linoleic acid was inversely proportionate (91.46%) wit prevailing temperatures. Differences due to environmenta conditions confirmed negative correlation of linoleic aci with prevailing temperature as already reported by Jone (1984).

Positive linear relationship of oil content and oleic acid wit GDD have suggested that it is possible to have high oil yiel with better quality at higher temperature. Linoleic acid i the best quality component of the oil which decreases wit increasing temperature in contrast to the oil yield. Th intersection point (Fig. 1) of oil yield and linoleic acid line may be the best compromise for high oil yield with the bes quality. Oil yield and linoleic acid lines intersected eac other at 2000 GDD. Sunflower hybrids maturing belo 2000 GDD would yield less oil while those at higher ma produce high oil yield but this gain will be at the cost of o quality.

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