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# Effect of different seasons on accumulation of oil and fatty acid content in sunflower (*Helianthus annuss*) germplasm accessions

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**Abstract**
To know the effect of seasons on seed yield, oil content and fatty acid accumulation in sunflower, a field experiment was conducted with 33 sunflower germplasm accessions comprising hybrids, CMS-lines, RHA-lines and inbreds. Significant and positive correlation was recorded for days to flowering, total dry matter (TDM) and total leaf area when compared between two seasons. A linear curve was obtained for seed yield, 100 achene weight and seed volume. CMS lines were most affected by season since they showed 40 percent reduction in the yield and the per cent reduction was less in inbreds. A very strong linear curve was obtained for test weight, TDM, harvest index and kernel to husk ratio. Oleic acid was significantly affected by both the seasons. Around 28 sunflower genotypes in our study produced higher oleic acid content in *rabi* than in *kharif*. For oil content non-significant differences were obtained though most of the genotypes were affected by high temperature during harvesting in rabi/summer.

**Keywords:** Correlation studies, fatty acids, growth parameters, oil content, sunflower, yield traits

## Introduction
Climatic variability is a major cause of inability of agricultural crops to achieve potential yield. Variations in the prevailing soil and climatic environments of the different seasons of sowing are characterized by differences in evaporative demand, temperatures, radiation and precipitation. Thus, contrasting season offer a valuable framework for studies of the challenges and potentials of crop-environment-management interactions of sunflower crop responses to seasonal water availability.
Sunflower is a rich source of edible oil (28-45%) and oil stability, plasticity and nutritional quality are largely determined by fatty acid composition mainly with percentage of oleic and linoleic acids, and saturated fatty acids (Claudio, F. *et al*., 2014) [2]. Sunflower growth and development are greatly influenced by the weather and the environment it is grown in. Temperature and amount of moisture in the soil are the major factors influencing sunflower seed oil composition and especially oleic acid content (Baldini *et al*., 2002) [1]. Fatty acid composition of sunflower is also affected by the genotype and its interaction with the environment. Genotype by environment interaction (GXE) has also been reported (Lajara *et al*., 1990) [3]. As a result, the study of G × E interaction for sunflower genotypes is necessary in order to select stable parental lines which help in development of trait based hybrids.
In this regard, a field experiment was carried out in kharif and rabi/summer season to analyze the stability of genotypes also which should be stable irrespective of the growing environment.

## Materials and method
A field experiment was conducted during *kharif* 2013 and *rabi*/summer 2013-14 at All India Coordinated Research Project on Sunflower, ZARS, UAS, GKVK, Bengaluru with 33 sunflower germplasm accessions comprising hybrids (3), CMS-lines (8), RHA-lines (7) and inbreds (5). These accessions were selected from our previous research based on the accumulation of oleic and linoleic acids using simple sequence repeat markers (SSR markers) with confirmation using gas chromatography (Nagarathna *et al*., 2011) [4]. During the crop growth period, several morphological, physiological and yield parameters were recorded.
Effect of different seasons (*kharif* and *rabi*/summer) on yield parameters was studied by correlating the seed yield with total dry matter, harvest index and total leaf area.

Similarly, the relationship between seasons on 50 percent flowering, total dry matter, total leaf area, seed volume, 100 seed weight, seed yield, harvest index and kernel to husk ratio was studied.

An attempt was made to know the correlation between different fatty acids in different seasons. Similar correlation studies were made between oil content with fatty acids *viz.*, oleic, linoleic, palmitic and stearic acid in both the seasons and the effect of oil content on different fatty acids in different seasons were also studied.

**Results and discussion**

Results of the experiment shows that there was a positive significant correlation between total leaf area (TLA) and TDM, seed yield and test weight, TDM and seed yield, seed yield and TLA (Fig.1). These results indicate that leaf area has contributed for increasing TDM. Hence leaf area is an important plant trait in influencing TDM and seed yield which was very clearly observed in *kharif* grown plants. The yield attributing trait 100 achene weight was directly contributed in increasing seed yield. However, harvest index did not influence the seed yield, which was also negatively related to TDM, indicating higher TDM reduces HI. A very strong linear curve was obtained for test weight, TDM, harvest index and kernel to husk ratio.

There was a positive correlation between *kharif* and *rabi*/summer for oil content, oleic acid and linoleic acid. The average from both the seasons is same (34.0) and though the maximum values were 41, minimum was less in *kharif* (17.7 per cent) and it was 23.6 per cent in *rabi*/summer 2013-14. CMS-17B and CMS-335A maintained low oil content consecutively for two seasons. The genotypes *viz*., GPR-17, GPR-30, RHA-86, GKVK-2, RHA-87, RHA-88, CMS-57A, CMS-58A, GPR-14 GPR-17 and GMU-702 maintained higher oil content irrespective of seasons (data not shown).

A positive correlation was observed for oil content and unsaturated fatty acids (oleic & linoleic acid), however the same was not recorded for saturated fatty acids (palmitic & stearic acid). For oil content non-significant differences were obtained though most of the genotypes were affected by high temperature during harvesting in rabi/summer. In all the hybrids, oleic content was increased whereas, linoliec content reduced. There was no such correlation observed for palmitic and stearic acid though the palmitic content was marginally higher than stearic acid content (Fig. 2). During our study period in *rabi*, temperature was higher (30°C) and maximum sunshine hours (8.6) was recorded which influenced a positive effect on oleic accumulation.

From all these results it could be concluded that sunflower generally exhibits the similar relationships for growth, physiological and morphological traits even in the different climatic condition by following the same ranks except oil percent and fatty acid composition which have greatly affected by weather parameters mainly by temperature.

Our study clearly indicates that, oleic acid content is increased under high temperature due to sensitive nature of fatty acid desaturase enzyme (FAD 2) which reduces the conversion of oleic to linoleic acid thereby increasing oleic content. Our current findings also help in better understanding of genotype and environmental effects on fatty acid composition which is needed to further improve oil quality.

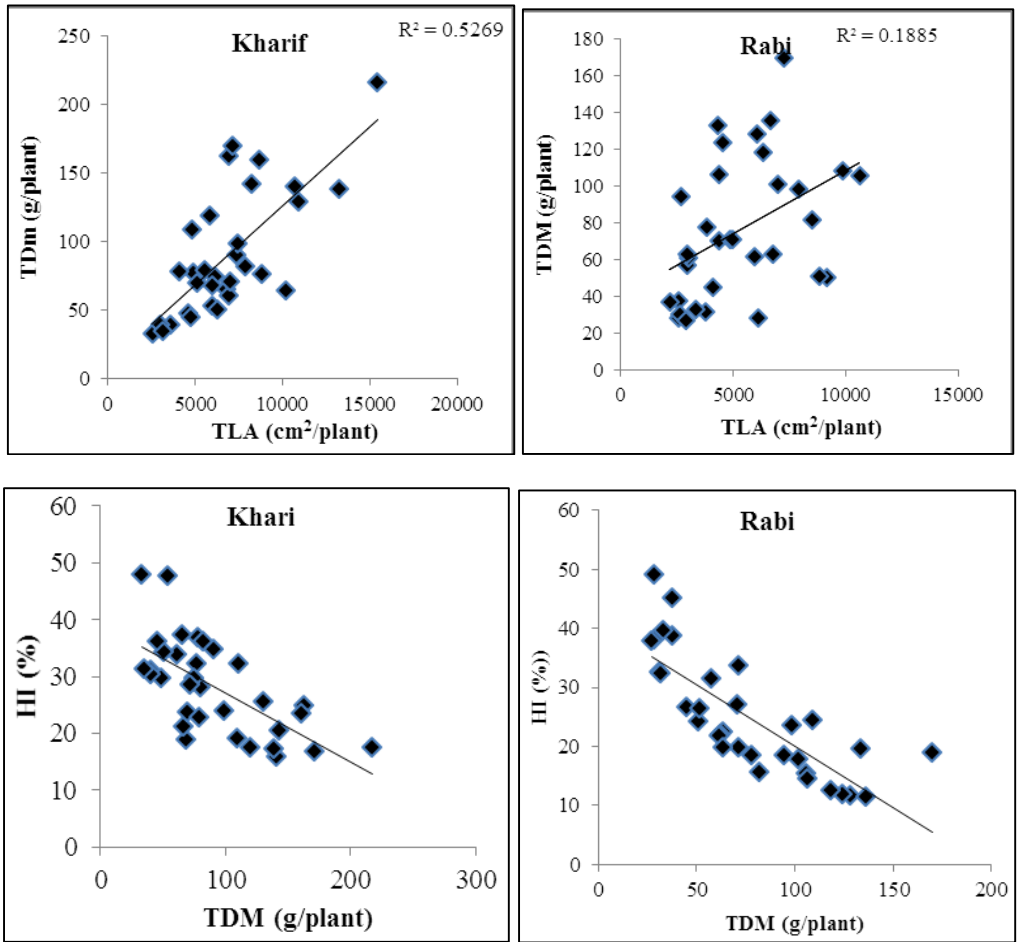


**Fig 1:** Genotypic correlation between TDM with TLA, HI in *kharif* and rabi/summer

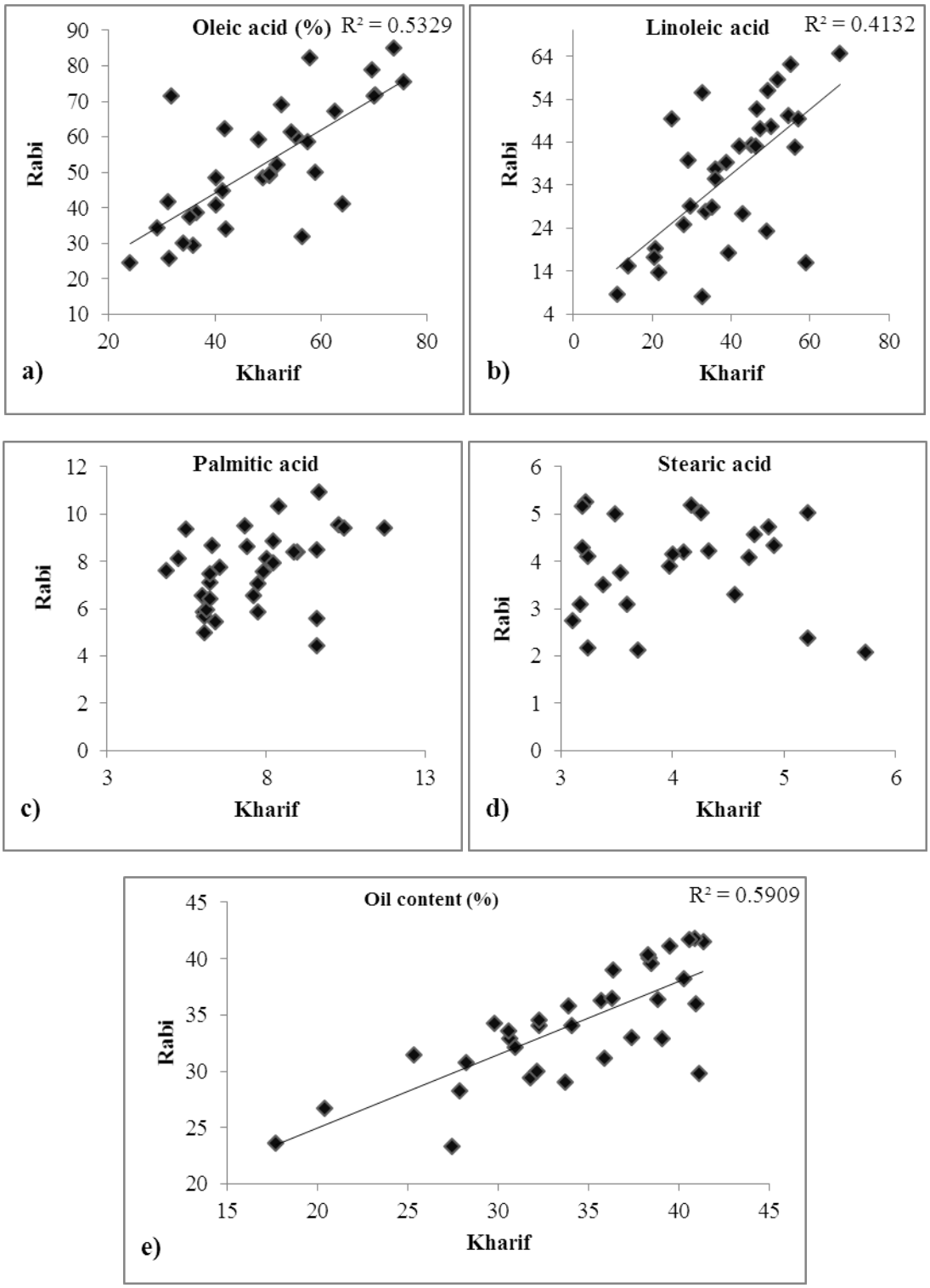


**Fig 2:** Performance of sunflower accessions for oil content and fatty acid composition in *kharif* and rabi/summer

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