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Correlation analysis for seed yield and its component traits in sunflower

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Abstract
Fifty sunflower genotypes were laid in a randomized block design following all recommended package of practices. Correlation studies revealed that seed yield per plant was positively and significantly associated with 100-seed weight, seed volume weight, head diameter, duration of reproductive phase and oil content. Oil content was positively associated with duration of reproductive phase, head diameter and seed volume weight, whereas the association between hull content and oil content was found to be highly significant and negative.

Keywords: correlation analysis, sunflower, seed yield and yield traits

Introduction
Sunflower (*Helianthus annuus* L.) is an important oilseed crop, which belongs to the genus '*Helianthus*' of the family '*Asteraceae*'. In India importing of vegetable oil is still undergoing process from other countries to meet the domestic requirements (Anonymous, 2014) [1]. Among vegetable oil sources, sunflower oil is preferred one and it is recommend to the heart patients due to its high Poly Unsaturated Fatty Acid (PUFA) content. Due to its high economic importance, the developments of effective hybrids are required with superior yield and quality traits. In sunflower, seed yield and oil content are complex traits which are affected by different factor which may act individually or collectively. The knowledge of association of several characters with yield and among themselves will be, therefore, very essential for planning a successful breeding programme (Chandirakala *et al.,* 2015) [5]. The efficiency of selection mainly depends on the direction and magnitude of association between yields and its components. Correlation describes the mutual relationship between the variables and helps to improve different characters simultaneously. Therefore, an attempt has been made to assess the correlation between yield and yield components.

Materials and Methods
To measure the correlation between seed yield and its component traits in sunflower, fifty genotypes were selected from sunflower germplasm maintained at the Oilseeds Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The experiment was conducted at Research Farm of CCS Haryana Agricultural University, Hisar during spring season in 2015. All 50 genotypes were grown in a randomized block design (RBD) with three replications, in double row plots of 3.5 m length each, keeping row to row and plant to plant distance of 45 cm and 30 cm, respectively. All the recommended package of practices was followed to raise the crop. At maturity five plants from each accession were selected randomly for collect data on yield and yield related characters *viz.,* days to 50% flowering (days), duration of reproductive phase (days), days to maturity, plant height (cm), stem girth (cm), head diameter (cm), seed yield, 100-seed weight (g), seed volume weight (g/100 ml), hull content (%) and oil content (%). The oil content of seeds was determined by the method of AOAC (1995). Statistical analysis has been done with R software.

Results and Discussion
Simple correlation coefficients among the yield and yield component characters in sunflower are presented in Figure 1.

Seed yield per plant *vs* other characters
Seed yield per plant was highly significant and positively associated with 100-seed weight (0.76), seed volume weight (0.75) and head diameter (0.64). Duration of Reproductive phase (0.40) and oil content (0.30) were significantly correlated with seed yield per plant.

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The present study is supported by the previous work done by Anto Mijic *et al.* (2009), Kumari and Sheoran (2012) [8], Prabhakaran *et al.* (2013) [13], Chander and Sheoran (2014) [4] and Rani *et al.* (2016) [15] indicated a positive relationship of different intensity between seed yield per plant and oil content. The character's plant height, stem girth and hull content had non-significant and positive association with seed yield per plant. The association between seed yield per plant and oil content with 10 quantitative characters is presented in figure: 2 and figure: 3, respectively.

Association between other characters
Days to 50% flowering exhibited highly significant and positive correlation with days to maturity (0.55), plant height (0.72) and stem girth (0.28), while it showed non-significant correlation with other characters. Such results are in concurrence with the results of Patil *et al.* (1996) [12], and Binodh *et al.* (2008). They found positive association of days to first flowering to the morpho-physiological and seed yield related traits. Duration of reproductive phase showed highly significant and positive correlation with days to maturity (0.40), head diameter (0.54), seed volume weight (0.36) and oil content (0.44). Days to maturity had significantly positive

correlation with plant height (0.30) whereas it was negatively associated with 100-seed weight (-0.28). Such results are in concurrence with the results of Rani *et al.* (2016) [15]. Plant height exerted positive and significant association with stem girth (0.35). Similar results were reported by Punia and Gill (1994) [14], Chikkadeviah *et al.* (2002), Gill *et al.* (2003) and Lakshminarayana *et al.* (2004) [9]. They reported that plant height was significantly correlated with other morpho-physiological and yield related traits.
Stem girth manifested positive and significant association with seed volume weight (0.28). Similar results were reported by Narayana and Patel (1998) and Gill *et al* (2003). Head diameter exerted significant positive correlation with 100-seed weight (0.48), seed volume weight (0.56), and oil content (0.41) which confirmed the findings of Rao (2013) and Sujatha & Nadaf (2013) [17]. The correlation between 100-seed weight and seed volume weight (0.63) was found to be positively significant. The similar results were reported in earlier findings of Lakshminarayana *et al.* (2004) [9]. Seed volume weight had significant and positive correlation with oil content (0.32) whereas the association between hull content and oil content was found to be highly significant and negative (figure: 2).
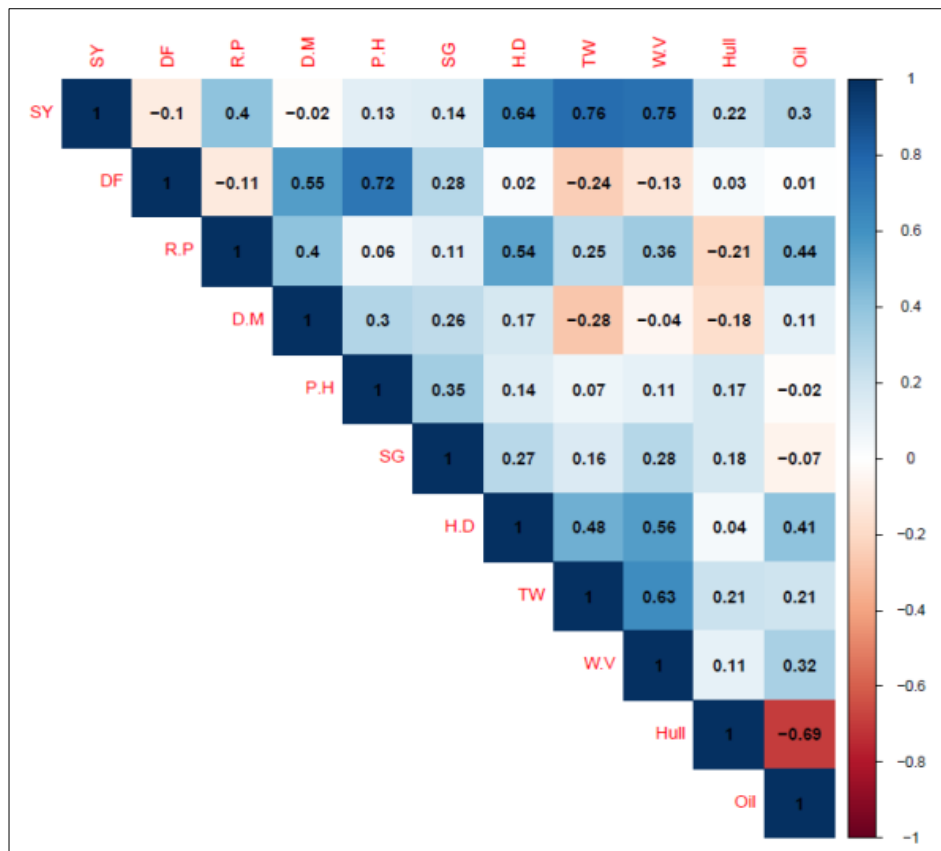
Critical values for Pearson's Correlation Coefficient: 0.05=0.278
0.01=0.361

Fig 1: Correlation coefficients for 11 quantitative characters in sunflower

Where: SY= Seed yield per plant (g), DF= Days to 50% flowering (days), RP= Duration of reproductive phase (days), DM= Days to maturity (days), PH= Plant height (cm), SG= Stem girth (cm), HD= Head diameter (cm), SW=100-seed weight (g), SVW= Seed volume weight (g/100 ml), HC= Hull content (%) and OC= Oil content (%)
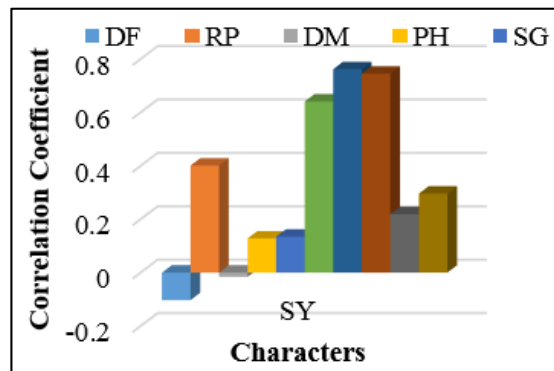
Fig 2: Correlation coefficient of 11 quantitative characters with seed yield in Sunflower

Where: SY= Seed yield per plant (g), DF= Days to 50% flowering (days), RP= Duration of reproductive phase (days), DM= Days to maturity (days), PH= Plant height (cm), SG= Stem girth (cm), HD= Head diameter (cm), SW=100-seed weight (g), SVW= Seed volume weight (g/100 ml), HC= Hull content (%) and OC= Oil content (%)

Fig 3: Correlation coefficient of 11 quantitative characters with oil content in sunflower

Where: SY= Seed yield per plant (g), DF= Days to 50% flowering (days), RP= Duration of reproductive phase (days), DM= Days to maturity (days), PH= Plant height (cm), SG= Stem girth (cm), HD= Head diameter (cm), SW=100-seed weight (g), SVW= Seed volume weight (g/100 ml), HC= Hull content (%) and OC= Oil content (%)
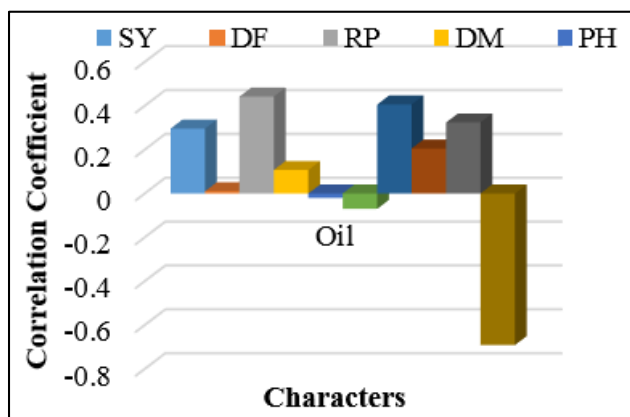
Conclusion
From the above discussion, it may be concluded that differential association was observed among these component characters. Due to the presence of significant and positively association between seed yield and 100-seed weight, seed volume weight, head diameter, revealed that the selection based on these traits would ultimately improve seed yield. It is also suggested that hybridization of genotypes possessing combination of above characters is most useful for obtaining desirable high yielding segregation.

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