ASSOCIATION AND PATH ANALYSIS OF YIELD COMPONENTS AND OIL PERCENTAGE IN SUNFLOWER (HELIANTHUS ANNUUS L.).

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Summary

The study was undertaken primarily to determine the nature and magnitude of association among yield components and oil percentage in sunflower cultivar 'Issanka'. The character studied were (i) seed yield (ii) plant height (iii) head diameter (iv) No. of seeds per head (v) 100 seed weight and (vi) oil percentage. Genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients in most of the traits, indicating the lack of environmental association among the characters. Yield was found positively associated with plant height, No. of seeds per head, head diameter and 100 seed weight but negatively - correlated with oil percentage. Path coefficient analysis showed that plant height had a negative direct effect on yield and up to a large extent contributed indirectly via head diameter. Head diameter had highest direct effect on yield. Although the correlation between seed yield and oil percentage was negative, however, path coefficient analysis revealed that later had a positive direct effect on the former suggesting to compromise between these two most important economic traits. Negative association, however, could be dissipated / minimized/ broken using intermating and/or mutagenesis provided linkage between seed yield and seed oil percentage is not too tight, and a simultaneous improvement in seed yield and oil percentage could be achieved.

Introduction

Sunflower (Helianthus annuus L.) is an important oil seed crop in Kenya. Varieties are being improved for better yield and high oil content in seeds. The Russian cultivar Issanka is a short duration variety with acceptable oil percentage but poor in seed yield. This cultivar can be grown successfully in marginal rainfall areas and high lands of Kenya where long duration varieties and hybrids cannot be grown. Hence a project was undertaken to improve the yield potential of cultivar Issanka using various breeding methods and exploiting genetic variability already present in this cultivar for yield. To proceed with, it was thought necessary to find out nature and magnitude of association among yield components and oil percentage. Correlation coefficients, however, are often misleading and cannot be relied upon as such. Path coefficient analysis as suggested by Wright (1921) and first demonstrated by Dewey and Lu (1959) in crop plants and later by many workers in several crops, is a potent tool in the hands of plant breeders. It can define cause and effect relationship in better way dividing simple correlation coefficients into direct and indirect (via other traits) effects. Yield as such is the function (effect) of various components (causal factors) considering direct and indirect effects on seed yield a plant breeder can lay emphasis on the most important

characters which are contributing directly and indirectly via other characters with higher magnitude.

Materials and Methods

Fifty selected progenies from cultivar Issanka (variable in nature) were grown in long rain season of 1982 using randomized block design with 3 replications in two tiers to avoid soil heterogenity. Each plot consists of one progeny row of 4.5 m long with fifteen plants in each row. Plant to plant distance was kept 30 cm and row to row 75 cm. All the normal agronomic practices were followed. The crop was irrigated twice due to lack of rains. The data were recorded on 10 randomly selected competitive plants from each progeny row replicationwise for (i) seed yield per plant (g) (ii) plant height (cm) (iii) head diameter (cm) (iv) total no. of seeds per head (v) 100 seed weight (g) and (vi) oil percentage (in seeds). The average values of 10 plants were used for statistical analysis. Genotypic and phenotypic correlation coefficients were calculated for all characters. Path coefficient analysis was carried out using phenotypic correlation coefficients as described by Dewey and Lu (1959).

Results

The analysis of variance for progeny rows revealed a broad spectrum of genetic variability for all the characters recorded, suggesting that the cultivar Issanka can be improved for its seed yield and oil content as well. Correlations:- It is evident from Table 1 that the genotypic correlation coefficients were on higher side than the corresponding phenotypic correlation coefficients except correlation between plant height and seed yield, 100 seed weight and plant height, indicating the lack of environmental association among the component characters. Seed yield had a highly significant positive phenotypic association with plant height (0.594), head diameter (0.385), and no. of seeds per head (0.467). Yield was also correlated significantly and positively with 100 seed weight. Oil percentage was found to be significantly negatively correlated with seed yield. Plant height had a highly significant positive association with head diameter and also significant and positive association with no. of seeds per head and 100 seed weight. The magnitude of correlation coefficient between head diameter and no. of seeds per head was found to be maximum and near to the unity (0.847). Head diameter had a significant positive correlation with 100 seed weight but significant negative association with oil percentage. There was a highly significant negative correlation between no. of seeds per head and 100 seed weight. Surprisingly 100 seed weight had a significant negative correlation with oil percentage. Path analysis:- Path coefficients were calculated using phenotypic correlations only (Table 2). Head diameter had highest direct effect on seed yield (3.114), followed by oil percentage while all other traits had negative direct effects on seed yield with different magnitudes. Plant height had a

Table 1. Phenotypic (P) and genotypic (G) correlation coefficients among yield, its components and oil percentage in sunflower (Helianthus annuus L.).

Characters		Plant height	Head diameter	No. of seeds per head	100 seed weight	Oil (content) percentage
Seed yield	P	0.594**	0.385**	0.467**	0.239*	-0.192*
	G	0.427	0.504	0.486	0.378	0.088
Plant height	P		0.639**	0.161*	0.147*	-0.094
	G		0.683	0.207	-0.063	-0.037
Head diameter	P			0.847**	0.182*	-0.173*
	G			0.903	0.231	-0.211
No. of seeds per head	P				-0.245**	0.076
	G				-0.326	0.098
100 seed weight	P					-0.158*
	G					0.057

Table 2. Direct (diagonal) and indirect effects (Path coefficients) of yield components on seed yield in sunflower (Helianthus annuus L.)

Characters	Plant height	Head diameter	No. of seeds per head	100 seed weight	oil (content) percentage	Phenotypic correlation with yield
Plant height	-0.998	1.994	-0.355	-0.094	0.047	0.594
Head diameter	-0.639	3.114	-1.870	-0.120	-0.090	0.385
No.of seeds per head	-0.161	2.637	-2.203	0.158	0.038	0.467
100 seed weight	-0.146	0.569	0.540	-0.645	-0.079	0.239
Oil(content) percentage	-0.094	-0.540	-0.167	0.102	0.507	-0.192

positive indirect effect via head diameter towards yield. Through other characters it had a negative indirect effect except oil percentage. Head diameter contributed negatively via no. of seeds per head, plant height, seed weight and oil percentage in that order. No. of seeds per head contributed positively through head diameter, 100 seed weight and oil percentage with decreasing magnitude and negatively through plant height. Although 100 seed weight had a negative direct effect on yield, however, it contributed positively via no. of seeds per head and head diameter. It had a negative effect on yield via plant height and oil percentage. Oil content had a positive direct effect on seed yield and positive indirect effect via 100 seed weight, while through head diameter, no. of seeds per head and plant height it contributed negatively.

Discussion

Path coefficient analysis revealed the true nature of relationship between yield and its components. Plant height which had a highly significant positive association with yield had a negative direct effect on yield meaning thereby that plant height has nothing to do with yield. Its contribution was mainly through head diameter. Thus to get an improvement in yield potential not very tall plants are required but plants with medium height and bigger head size can bring about improvement in seed yield. Pathak (1974) reported highly significant positive correlation between plant height and seed yield, while partial correlation between these two characters was found to be negative and significant (Skoric 1974).

The most important component character of yield appeared to be the head diameter in this study. It had a highly significant positive association and highest positive direct effect on seed yield. Kloczowski (1974) reported highly significant positive correlation between head diameter and seed yield. No. of seeds per head and head diameter although had positive and highly significant correlation with seed yield but their direct effect on seed yield was negative. Oil percentage which had a significant negative correlation with yield contributed positively directly towards yield indicating that plants with better oil content may give higher seed yield or vice versa. Skoric (1974) also reported negative association of oil content with seed yield. Oil percentage had a negative indirect effect on seed yield via head diameter and no. of seeds per head. Taking into consideration the direct and indirect effect of oil percentage on seed yield it became amply clear that a breeder had to compromise between had size and oil percentage, and cannot sacrifice one on the expense of other because bigger head size will certainly result in higher seed yield but low oil content. However the negative association between head diameter/seed yield and oil percentage could be dissipated/minimized/broken provided the linkage among genes governing these traits was not too light. To achieve this goal planned intermating in selected original population or segregating generations was suggested as had been performed in other crops like cotton to break/dissipate the negative correlation between yield and

fibre length (Tyagi 1978, Dhanda et al., 1982). Mutation breeding may also help in breaking this negative association between these two economically important characters in sunflower.

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