International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 1117-1124

Received: 25-09-2018
Accepted: 30-10-2018

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Study the estimates of correlation coefficient for genotypic and phenotypic level among different characters, correlation between yield and yield contributing traits in tuberose

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Abstract
In the present investigation, at the Horticultural Research Centre, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (UP), during the year of 2015-2016 on "Study the estimates of correlation coefficient for genotypic level among different character's and correlation between yield and yield contributing traits. All twenty-two genotypes were grown in randomized block design with 3 replications with row to row and plant to plant spacing of 30 cm and 20 cm, respectively during 2015-16. High heritability coupled with high genetic advance was observed for length of longest leaf, number of bulbs per plant and number of bulblets per plant. Bulb yield exhibited significant and positive association with days taken to sprouting, plant height, length of longest leaf, width of longest leaf, days required for visibility of first spike, days taken to opening of first flower, number of florets per spike, number of spikes per bulb, number of bulbs per plant, number of bulblets per plant, yield of bulb per plant, diameter of bulb, yield of bulb and bulblets per plant at both genotypic and phenotypic level. This might be due to linkage of genes determining these characters. Thus, it can be inferred that selection based on any one of these characters either alone or in combination, will help to identifying high yielding genotypes. Genotypic correlation was of higher magnitude as compare to their corresponding phenotypic correlation in most of the character combination, thereby, suggesting strong inherent association between genotypic and phenotypic level.

Keywords: estimates, coefficient, phenotypic, characters, contributing

Introduction
The tuberose *Polianthes tuberosa* (Linn.), is a night-blooming perennial plant, belongs to the family Asparagaceae and thought to be native to Mexicoalong with every other species of *Polianthes* (Benschop, 1993) [6]. The common name of *Polianthes tuberosa* derives from the Latin *tuberosa*, meaning swollen or tuberous in reference to its root system and *Polianthes* means "many flowers" in Greek language.

Tuberose is having elongated spikes up to 45 cm long that produce clusters of fragrant waxy white flowers that bloom from the bottom towards the top of the spike. It has long, bright green leaves clustered at the base of the plant and smaller, clasping leaves along the stem. Plant height 60-120 cm long and propagated through bulb like tuberous root stock, covered with broadened bases of fleshy leaves forming arosette, 6-9 in number, 3-4.5 cm long and about 1.5 cm wide. It occupies a prime place among the bulbous ornamentals because of its elegant, highly fragrant flowers, which can be used in various ways. (Sheela, 2008) [16].

The area under floriculture production in India was 255.00 thousand hectares with a production of 1,754 thousand metric tons loose flowers and 543 thousand metric tons cut flowers during 2013-14 (Anonymous, 2015) [1]. Floriculture is now commercially cultivated in several states with West Bengal (32%), Karnataka (12%) Maharashtra (10%), having gone ahead of other producing states like Madhya Pradesh, Gujarat, Punjab, Haryana, Andhra Pradesh, Orissa, Jharkhand, Uttar Pradesh and Chhattisgarh. India's total export of floriculture was Rs. 455.90 crores in 2013-14. The major importing countries were United States, Netherlands, Germany, United Kingdom, United Arab Emirates, Japan and Canada.

The flowers of tuberose produce one of the rarest and most valuable aromas with sweet and pleasant fragrance.

In the last two decades or so a few new tuberose cultivars have been identified and recommended for commercial cultivation in different regions of our country. Several cultivars had been assessed and evaluated for their performance under different regions of the country taking single petalled and double petalled cultivars together by Bankar and Mukhopadhyay (1980) [5], Bhattacharjee *et al.*, (1981) [7], Pratap and Manohar Rao (2003) and Singh and Misra (2005) [14] and have revealed that a market.

The knowledge about the factors responsible for yield is a difficult problem as yield is a complex character and an interactive effect multiplication of different traits. Therefore, for achievement of high yield level, the breeder is required to simplify this complex situation. Thus the study of correlation between yield and its components is of prime importance in formulating the selection criteria. Selection is generally based on the phenotypic values of a character which partly determined by genotypes which is heritable, and partly by environment which is non-heritable. The characters that are largely influenced by environment are said to have low heritability while those which are less susceptible to environment variation shows high heritability. Paroda and Joshi (1970) [11] referred the idea about heritability.

The study of genetic advance is equally important as it measures the genetic gain based on selection in a particular character. Therefore, any crop improvement programme through selection, the study of genetic variability and heritability together with genetic advance is necessary. A number of variables are studied in correlation, which give an idea about indirect selection. Indirect selection is equally important in influencing the final product, grain yield in any crop species.

Materials and Methods

The detail of experiment is given below

Experimental design	-	**Randomized Block Design**
Number of treatments	-	22
Number of replications	-	3
Spacing	-	30 cm x 20 cm
Plot size	-	10 m^2
Total number of plots	-	66
Total area of experimental field	-	1188 m^2
Main irrigation channel	-	1
Sub irrigation channel	-	2
Date of sowing	-	April, 22th 2015

Field preparation

The land of experimental field was prepared by ploughing before planting of bulbs. At last ploughing well-rotten FYM @400q/ha was applied. Besides of FYM, a recommended doses of N: P: K @ 120:150:150 kg /ha were also added into the experiment, out of which 60 kg N and entire dose of P_2O_5 and K_2O are applied as basal dose. The remaining N was applied in two split doses (30 +30 kg), 30 and 60 days after planting.

Planting

Tuberose bulbs were planted on April 22, 2015, at 30x20 cm spacing and 4.0 cm depth.

Aftercare

After planting, irrigation was applied at 7-8 day interval and weeding with a gap of 15-20 days is required during the crop period. Weeding was done, manually, by hand hoe.

Estimation of correlation coefficient

Correlation was estimated the association between various character-pairs. The correlations at genotypic, phenotypic and environmental levels were estimated from the analysis of variance and covariance as suggested by Searle (1961).

1. Phenotypic correlation between character x and y

$$r_{xy}(p) = \frac{Cov_{xy}(p)}{\sqrt{Var_x(p) \times Var_y(p)}}$$

Where,

Cov_{xy} (p) = Phenotypic covariance between two characters x and y.

Var_x (p) = Phenotypic variance for characters x.

Var_y (p) = Phenotypic variance for characters y.

Statistical analysis

The following statistical procedures were followed in the present investigation:

Analysis of variance, Heritability and genetic advance, Correlation, Path coefficient analysis and Genetic divergence

The data collected from the experiments during the year 2015-16 were subjected to statistical analysis. The statistical methods used to obtain various values are described below:

Analysis of variance

The mean values of genotypes in each replication were used for statistical analysis. The data were analyzed for a randomized block design to test the significance of differences between the genotypes for various characters. The analysis of the data was as described by Panse and Sukhatme (1969) [10].

The following mathematical model was used in the analysis

$$Yij = \mu + ti + bj + eij$$

Where, i= 1, 2, 3, 4,……t, number of treatments (t)

J = 1, 2, 3, 4,……r, number of replications (r)

Yij = Performance of i^{th} genotype in j^{th} replication

μ = general mean of the population

ti = effect of i^{th}treatment

bj = effect of j^{th} replication

eij = random error associated with i^{th} treatment and j^{th} block

The partitioning of total variance, due to block, treatments and error and them expectationis in the Table 3.2:

Source of variance	df	Mean square	F value
Replication	r-1	MSr	MSt/MSe
Genotypes	t-1	MSt	
Error	(r-1)(t-1)	MSe	
Total	(rt-1)		

Where,

r = number of replications

t = number of genotypes

df = degree of freedom

MSr = Mean square for replication

MSt = Mean square for treatment

MSe = Mean square for error

Genotypic variance ($\sigma^2 g$) = (MSt/MSe)/r

Phenotypic variance ($\sigma^2 p$) = $\sigma^2 g + \sigma^2 e$

Error variance ($\sigma^2 e$) = MSe

The significance of differences among treatment means was tested by 'F' test at 5% or1% level of significance. Whenever,

the 'F' value was found to be significant, critical difference was calculated to test the significance of difference between treatment means as follows:

CD = SEd × t (5%) at error d.f.

Where,
t = table value of't' at error d.f.
SEd = standard error of difference between two treatment means

$$SEd = \sqrt{2\,MSe\ / r}$$

Where,
MSe = Mean sum square of error
r = Number of replications

Result

Estimation of Correlation coefficient

The inter relationship of yield and its contributing traits as represented by genotypic and phenotypic correlation coefficient among all the characters are presented in tables 1 and 1. (i) Showed that all most characters exhibited genotypic correlation to each other in positive and negative ways, which are given below. At genotypic level, Days taken to sprouting showed positive and significant correlation with plant height (0.310), number of leaves per plant (0.499), length of longest leaf (0.301), number of sprouts per bulb (0.487), number of florets per spike (0.679), number of spikes per bulb (0.678), length of spike (0.354), number of bulbs per plant (0.666), number of bulblets per plant (0.814), yield of bulb per plant (0.722), diameter of bulb (0.529),yield of bulb and bulblets per plant (0.742), yield of bulb (0.723), positive and non-significant correlation revealed for the width of longest leaf (0.167), days required for the visibility for the first spike (0.103), days taken to opening of first flower (0.122), diameter of flower (0.21), length of rachis (0.183). Whereas, negative but non-significant correlation was noted with diameter of spike (-0.015), longevity of spike (-0.128) and vase life (-0.055).

Plant height exhibited positive and significant correlation with length of longest leaf (1.00), width of longest leaf (0.323), number of sprouts per bulb (0.294), days required for visibility of first spike (0.606), days taken of opening of first flower (0.650), number of florets per spike (0.354), diameter of flower (0.252), length of spike (0.605), vase life (0.320), yield of bulb per plant (0.320), diameter of bulb (0.689), yield of bulb and bulblets per plant (0.318), yield of bulb (0.321). Positive and non-significant correlation with number of spikes per bulb (0.110), diameter of spike (0.191), length of rachis (0.034), longevity of spike (0.019), number of bulbs per plant (0.006), number of bulbs per plant (0.182) Whereas negative but significant correlation with number of leaves per plant (-0.281).

Number of leaves per plant showed positive and significant correlation with width of longest leaf (0.301), number of sprouts per bulb (0.646), number of spikes per bulb (0.320), length of rachis (0.413), number of bulbs per plant (0.244), number of bulblets per plant (0.243). Positive but non-significant correlation revealed with number of florets per spike (0.166), diameter of flower (0.043), length of spike (0.001), longevity of spike (0.168), vase life (0.013). Negative but significant correlation with length of longest leaf (-0.271), days required for visibility of first spike (-0.635), days taken to opening of first flower (-0.626), diameter of bulb (-0.795). Negative but non-significant correlation with diameter of spike (-0.128), yield of bulb per plant (-0.131), yield of bulb and bulblets per plant (-0.119) and yield of bulb (-0.131).

Length of longest leaf showed positive and significant correlation with width of longest leaf (0.322), number of sprouts per bulb (0.291), days required for visibility of first spike (0.603), days taken to opening of first flower (0.646), number of florets per spike (0.364), diameter of flower (0.256), length of spike (0.601), vase life (0.306), yield of bulb per plant (0.309), diameter of bulb (0.684), yield of bulb and bulblets per plant (0.307) and yield of bulb (0.309). Positive and non-significant revealed with number of spikes per bulb (0.107), diameter of spike (0.159), length of rachis (0.051), number of bulbs per plant (0.011), number of bulblets per plant (0.190). Negative and non-significant with longevity of spike (-0.008).

Width of longest leaf showed positive and significant correlation with number of florets per spike (0.558), number of spikes per bulb (0.290), number of sprouts per bulb (0.446), diameter of spike (0.362), number of bulbs per plant (0.455), number of bulblets per plant (0.516), yield of bulb per plant (0.352), yield of bulb and bulblets per plant (0.374), yield of bulb (0.352). Positive but non-significant revealed with length of spike (0.040), longevity of spike (0.207), diameter of bulb (0.110). Negative and non-significant correlation with days required for visibility of first spike (-0.165), days taken to opening of first flower (-0.111), diameter of flower (-0.121), length of rachis (-0.067) and vase life (-0.065).

Number of sprouts per bulb show positive and significant correlation with diameter of flower (0.315), number of spikes per bulb (0.577), diameter of spike (0.464), length of spike (0.535), length of rachis (0.599), longevity of spike (0.460) and vase life (0.493). Positive and non-significant correlation with number of florets per spike (0.159), number of bulbs per plant (0.240), number of bulblets per plant (0.231), yield of bulb per plant (0.107), yield of bulb and bulblets per plant (0.128) and yield of bulb (0.107). Negative but significant with days taken for first spike (-0.270). Whereas negative but non-significant with days taken to opening of first slower (-0.229) and diameter of bulb (-0.053)

Days required for visibility of first spike showed positive but significant correlation with days taking opening of first flower (0.998), number of florets per spike (0.305), vase life (0.440), yield of bulb per plant (0.336), diameter of bulb (0.750), yield of bulb and bulblets per plant (0.338), and yield of bulb (0.366). Positive but non-significant correlation with diameter of flower (0.230), diameter of spike (0.042), length of spike (0.166). Negative and significant correlation with length of rachis (-0.245). Negative and non-significant correlation with number of spikes per bulb (-0.213), longevity of spike (-0.162), number of bulbs per plant (-0.224), number of bulblets per plant (-0.151).

Days taken to opening of first flower showed positive and significant correlation with number of florets per spike (0.335), diameter of flower (0.290), length of spike (0.251), vase life (0.391), yield of bulb per plant (0.346), diameter of bulb (0.661), yield of bulb and bulblets per plant (0.315), yield of bulb (0.346). Positive and non-significant with diameter of spike (0.154). Negative and significant correlation with number of spikes per bulb (-0.278) and number of bulbs per plant (-0.297). Negative and non-significant correlation with length of rachis (-0.213), longevity of spike (-0.180) and number of bulblets per plant (-0.173).

Number of florets per spike showed positive and significant correlation with number of spikes per bulb (0.248), vase life (0.286), number of bulbs per plant (0.456), number of bulblets per plant (0.617), yield of bulb per plant (0.719), yield of bulb and bulblets per plant (0.722) and yield of bulb (0.719). Positive and non-significant with diameter of spike (0.057), diameter of flower (0.129), diameter of bulb (0.161). Negative and non-significant correlation with length of spike (-0.002), length of rachis (-0.059) and longevity of spike (-0.158).

Diameter of flower showed positive and significant correlation with length of spike (0.385), longevity of spike (0.394) and vase life (0.646). Positive and non-significant correlation with diameter of spike (0.121), length of rachis (0.172) and diameter of bulb (0.045). Negative and significant correlation with number of spikes per bulb (-0.267), number of bulbs per plant (-0.498) and number of bulblets per plant (-0.376). Negative and non-significant correlation with yield of bulb per plant (-0.233), yield of bulb and bulblets per plant (-0.232) and yield of bulb (-0.232).

Number of spikes per bulb showed positive and significant correlation with length of rachis (0.359), number of bulbs per plant (0.848), number of bulblets per plant (0.720), yield of bulb per plant (0.508), yield of bulb and bulblets per plant (0.542) and yield of bulb (0.508). Positive with non-significant correlation with diameter of spike (0.166), length of spike (0.148), vase life (0.085) and diameter of bulb (0.146). Negative and non-significant correlated with longevity of spike (-0.006).

Diameter of spike showed positive and significant correlation with length of spike (0.463). Positive with non-significant correlation with length of rachis (0.155), longevity of spike (0.111), vase life (0.014), number of bulbs per plant (0.066), number of bulblets per plant (0.082), yield of bulb per plant (0.197), yield of bulb and bulblets per plant (0.191) and yield of bulb (0.197). Negative with significant correlation with diameter of bulb (-0.147).

Length of spike showed positive and significant correlation with length of rachis (0.608). Positive with non-significant correlation with longevity of spike (0.231), vase life (0.184), number of bulblets per plant (0.112) and yield of bulb and bulblets per plant (0.006). Negative with non-significant correlated with number of bulbs per plant (-0.011), yield of bulb per plant (-0.004), diameter of bulb (-0.054) and yield of bulb (-0.004).

Length of rachis showed positive and non-significant correlation with longevity of spike (0.208), vase life (0.020), number of bulbs per plant (0.201) and number of bulblets per plant (0.143). Negative and significant correlation with diameter of bulb (-0.294). Negative and non-significant correlation with yield of bulbs per plant (-0.109), yield of bulbs and bulblets per plant (-0.099) and yield of bulb (-0.109).

Longevity of spike showed negative and non-significant with vase life (-0.063), number of bulbs per plant (-0.192), number of bulblets per plant (-0.171), yield of bulb per plant (-0.110), diameter of bulb (-0.123), yield of bulb and bulblets per plant (-0.096) and yield of bulb (-0.110)

Vase life showed positive and significant correlated with diameter of bulb (0.473). Positive and non-significant correlation with yield of bulb per plant (0.154), yield of bulbs and bulblets per plant (0.160) and yield of bulb (0.154). Negative and non-significant with number of bulbs per plant (-0.183) and number of bulblets per plant (-0.062).

Number of bulbs per plant showed positive and significant correlation with number of bulblets per plant (0.908), yield of bulb per plant (0.640), yield of bulbs and bulblets per plant (0.675) and yield of bulb (0.640). Negative and non-significant with diameter of bulb (-0.025).

Number of bulblets per plant showed positive with significant correlation with yield of bulbs per plant (0.634), yield of bulbs and bulblets per plant (0.671) and yield of bulb (0.634). Negative with non-significant correlation with diameter of bulb (-0.145).

Yield of bulb per plant showed positive and significant correlated with diameter of bulb (0.346), yield of bulb and bulblets per plant (0.998) and yield of bulb (0.999).

Diameter of bulb showed positive with significant correlation with yield of bulbs and bulblets per plant (0.339) and yield of bulb (0.346).

Yield of bulb and bulblets per plant revealed positive and significant correlated with yield of bulb (0.998).

As from the data presented in tables 2 and 2. (i) all most characters phenotypic correlated to each other in positive and negative ways, which are given below:

Days taken to sprouting showed positive and significant correlation with number of leaves per plant (0.359), number of sprouts per bulb (0.250), number of florets per spike (0.352), number of spikes per bulb (0.329), number of bulbs per plant (0.324), number of bulblets per plant (0.421), yield of bulb per plant (0.338), yield of bulb and bulblets per plant (0.346) and yield of bulb (0.338). Positive with non-significant correlated with plant height (0.212), length of longest leaf (0.226), width of longest leaf (0.203), days required for visibility of first spike (0.002), days taken to opening of first flower (0.006), diameter of flower (0.084), diameter of spike (0.116), length of spike (0.207), length of rachis (0.123), longevity of spike (0.028), vase life (0.093) whereas negative and non-significant correlated with diameter of bulb (-0.035)

Plant height showed positive and significant correlation with length of longest leaf (0.995), number of sprouts per bulb (0.254), days required for visibility of first spike (0.578), days taken to opening of first flower (0.567), number of florets per spike (0.324), length of spike (0.589), yield of bulb per plant (0.295), diameter of bulb (0.481), yield of bulb and bulblets per plant (0.294) and yield of bulb (0.295). Positive and non-significant correlated with width of longest leaf (0.195), diameter of flower (0.213), number of spikes per bulb (0.096), diameter of spike (0.168), length of rachis (0.056), vase life (0.207), number of bulbs per plant (0.007) and number of bulblets per plant (0.195). Negative and non-significant correlated with number of leaves per plant (-0.208) and longevity of spike (-0.008).

Number of leaves per plant showed positive and significant correlated with number of sprouts per bulb (0.585), number of spikes per bulb (0.292), length of rachis (0.330). Positive and non-significant correlated with width of longest leaf (0.228), number of florets per spike (0.12), diameter of flower (0.074), length of spike (0.023), longevity of spike (0.068), vase life (0.008), number of bulbs per plant (0.217) and number of bulblets per plant (0.228). Negative and significant correlated with days required for visibility of spike (-0.554) and days taken for opening of first flower (-0.516). Whereas negative and non-significant is showed in length of longest leaf (-0.188), diameter of spike (-0.033), yield of bulb per plant (-0.092), diameter of bulb (-0.213), yield of bulb and bulblets per plant (-0.08) and yield of bulb (-0.091).

Length of longest leaf showed positive and significant correlated with number of sprouts per bulb (0.245), days required for visibility of first spike (0.571), days taken to opening of first flower (0.565), number of florets per spike

(0.337), length of spike (0.585), yield of bulb per plant (0.284), diameter of bulb (0.476), yield of bulb and bulblets per plant (0.284), yield of bulb (0.284). positive and non-significant correlated with width of longest leaf (0.206), diameter of flower (0.22), number of spikes per bulb (0.093), diameter of spike (0.167), length of rachis (0.079), vase life (0.223), number of bulbs per plant (0.011), number of bulblets per plant (0.199) whereas negative and non-significant with longevity of spike (-0.018).

Width of longest leaf revealed positive and significant correlation in number of florets per spike (0.386), number of bulbs per plant (0.365), number of bulblets per plant (0.345), yield of bulbs per plant (0.277), yield of bulb and bulblets per plant (0.285) and yield of bulb (0.276). positive and non-significant correlated in number of sprouts per bulb (0.241), number of spikes per bulb (0.233), diameter of spike (0.208), length of spike (0.019), longevity of spike (0.144) vase life (0.064) and diameter of bulb (0.105). However negative and non-significant observed in days required for visibility of first spike (-0.157), days taken to opening of first flower (-0.113), diameter of flower (-0.038) and length of rachis (-0.057).

Number of sprouts per bulb showed positive and significant with number of spikes per bulb (0.462), length of spike (0.422) and length of rachis (0.427). Positive and non-significant correlated with number of florets per spike (0.064), diameter of flower (0.197), diameter of spike (0.24), longevity of spike (0.206), vase life (0.145) number of bulbs per plant (0.21), number of bulblets per plant (0.224), yield of bulb per plant (0.078), diameter of bulb (0.022), yield of bulb and bulblets per plant (0.095) and yield of bulb (0.078) whereas negative and non-significant correlated with days required for visibility of first spike (-0.237) and days taken for opening of first flower (-0.166).

Days required for visibility of first spike revealed positive and significant correlation with days taken of opening of first flower (0.910), number of florets per spike (0.280), vase life (0.317), yield of bulb per plant (0.341), diameter of bulb (0.448), yield of bulb and bulblets per plant (0.316) and yield of bulb (0.341). Positive and non-significant with diameter of flower (0.204), diameter of spike (0.049) and length of spike (0.16). Whereas negative and mom significant correlated with number of spike per bulb (-0.21), length of rachis (-0.222), longevity of spike (-0.109), number of bulbs per plant (-0.206) and number of bulblets per plant (-0.143).

Days taken to opening of first flower showed positive and significant with number of florets per spike (0.314), vase life (0.301), yield of bulb per plant (0.281), diameter of bulb (0.362), yield of bulb and bulblets per plant (0.252) and yield of bulb (0.281). Positive and non-significant with diameter of flower (0.208), diameter of spike (0.149) and length of spike (0.215). Negative and significant only with number of bulbs per plant (-0.252) whereas negative with non-significant with number of spikes per bulb (-0.241), length of spike (-0.18), longevity of spike (-0.125) and number of bulblets per plant.

Number of florets per spike showed positive and significant correlated with number of bulbs per plant (0.409), number of bulblets per plant (0.547), yield of bulb per plant (0.647), yield of bulbs and bulblets per plant (0.652) and yield of bulb (0.647). Positive with non-significant in characters are diameter of flower (0.09), number of spikes per bulb (0.212), diameter of spike (0.121), vase life (0.191), diameter of bulb (0.116). Negative and non-significant are in length of spike (-0.016), length of rachis (-0.064) and longevity of spike (-0.12).

Diameter of flower showed positive with significant in length of spike (0.363), longevity of spike (0.286) and vase life (0.380) however positive with non-significant are diameter of spike (0.58), length of rachis (0.195) and diameter of bulb (0.136). Negative with significant showed in number of bulbs per plant (-0.417) and number of bulblets per plant (-0.292) whereas non-significant are number of spikes per bulb (-0.194), yield of bulb per plant (-0.163), yield of bulb and bulblets per plant (-0.16) and yield of bulb (-0.163).

Number of spikes per bulb revealed positive and significant in length of rachis (0.308), number of bulbs per plant (0.819), number of bulblets per plant (0.699), yield of bulb per plant (0.483), yield of bulbs and bulblets per plant (0.517) and yield of bulb (0.483). Positive and non-significant are diameter of spike (0.09), length of spike (0.137), vase life (0.026) and diameter of bulb (0.097) whereas negative non-significant in longevity of spike (-0.028).

Diameter of spike showed positive and significant in length of spike whereas non-significant in length of rachis (0.181), longevity of spike (0.045), vase life (0.198), number of bulbs per plant (0.047), number of bulblets per plant (0.09), yield of bulb per plant (0.183), yield of bulbs and bulblets per plant (0.185) and yield of bulb (0.183). Negative with non-significant are diameter of bulb (-0.015).

Length of spike showed positive and significant with length of rachis (0.594) whereas non-significant with longevity of spike (0.191), vase life (0.128), number of bulblets per plant (0.116), diameter of bulb (0.005), yield of bulbs and bulblets per plant (0.004) however, negative with non-significant in number of bulbs per plant (-0.005), yield of bulb per plant (-0.008) and yield of bulb and bulblets per plant (-0.008).

Length of rachis showed positive and non-significant with longevity of spike (0.131), vase life (0.061), number of bulbs per plant (0.195) and number of bulblets per plant (0.145) whereas negative and non-significant in yield of bulb per plant (-0.092), diameter of bulb (-0.139), yield of bulb and bulblets per plant (-0.079) and yield of bulb (-0.092).

Longevity of spike showed positive with non-significant in vase life (0.094). Negative and non-significant with number of bulbs per plant (-0.161), number of bulblets per plant (-0.135), yield of bulb per plant (-0.09), diameter of bulb (-0.015), yield of bulb and bulblets per plant (-0.085) and yield of bulb (-0.09).

Vase life revealed positive and non-significant with yield of bulb per plant (0.116), diameter of bulb (0.235), yield of bulb and bulblets per plant (0.115) and yield of bulb (0.116), whereas negative and non-significant with number of bulbs per plant (-0.105) and number of bulblets per plant (-0.069)

Number of bulbs per plant showed positive with significant in number of bulblets per plant (0.887), yield of bulb per plant (0.613), yield of bulb and bulblets per plant (0.649) and yield of bulb (0.606) whereas non-significant in diameter of bulb (0.026).

Number of bulblets per plant revealed positive and significant with yield of bulb per plant (0.606), yield of bulb and bulblets per plant (0.646) and yield of bulb (0.606). Negative and non-significant in diameter of bulb (-0.045)

Yield of bulb per plant showed positive and significant in diameter of bulb (0.252), yield of bulb and bulblets per plant (0.997) and yield of bulb (0.999)

Diameter of bulb showed positive and significant effect in yield of bulb and bulblets per plant (0.250) and yield of bulb (0.252).

Yield of bulb and bulblets per plant showed positive and significant correlated with yield of bulb (0.997). Conformity with the Anuradha *et al.*, 2002 [4], Singh *et al.*, 2013 [15] and Rashmi *et al.*, 2012 [13] Kannan *et al.*, 1998 [9].

Table 1: Estimates of correlation coefficient for genotypic level among different characters in tuberose.

Characters	Days taken to sprouting	Plant height (cm)	No. of leaves per plant	Length of longest leaf (cm)	Width of longest leaf (cm)	No. of sprouts per bulb	Days required for visibility of first spike	Days taken to opening of first flower	No. of florets per spike	Diameter of flower (cm)	No. of spikes per bulb	Yield of bulb (q/ha)
Days taken to sprouting	1.000	0.310*	0.499**	0.301*	0.167	0.487**	0.103	0.122	0.679**	0.210	0.678**	0.723**
Plant height (cm)		1.000	-0.281*	1.000**	0.323**	0.294*	0.606**	0.650**	0.354**	0.252*	0.110	0.321**
No. of leaves per plant			1.000	-0.271*	0.301*	0.646**	-0.635**	-0.626**	0.166	0.043	0.320**	-0.131
Length of longest leaf (cm)				1.000	0.322**	0.291*	0.603**	0.646**	0.364**	0.256*	0.107	0.309*
Width of longest leaf (cm)					1.000	0.446**	-0.165	-0.111	0.558**	-0.121	0.290*	0.352**
No. of sprouts per bulb						1.000	-0.270*	-0.229	0.159	0.315**	0.577**	0.107
Days required for visibility of first spike							1.000	0.998**	0.305*	0.235	-0.213	0.366**
Days taken to opening of first flower								1.000	0.335**	0.290*	-0.278*	0.346**
No. of florets per spike									1.000	0.129	0.248*	0.719**
Diameter of flower (cm)										1.000	-0.267*	-0.232
No. of spikes per bulb											1.000	0.508**
Yield of bulb (q/ha)												1.000

*,** significant at 5% and 1% level, respectively

Table 1(i): Estimates of correlation coefficient for genotypic level among different characters in tuberose.

Characters	Diameter of spike (mm)	Length of spike (cm)	Length of rachis (cm)	Longevity of spike	Vase life	No. of bulbs per plant	No. of bulblets per plant	Yield of bulb per plant(gm)	Diameter of bulb(mm)	Yield of bulb and bulblets per plant (q/ha)	Yield of bulb (q/ha)
Diameter of spike (mm)	1.000	0.463**	0.155	0.111	0.014	0.066	0.082	0.197	-0.147	0.191	0.197
Length of spike (cm)		1.000	0.608**	0.231	0.184	-0.011	0.112	-0.004	-0.054	0.006	-0.004
Length of rachis (cm)			1.000	0.208	0.020	0.201	0.143	-0.109	-0.294*	-0.099	-0.109
Longevity of spike				1.000	-0.063	-0.192	-0.171	-0.110	-0.123	-0.096	-0.110
Vase life					1.000	-0.183	-0.062	0.154	0.473**	0.160	0.154
No. of bulbs per plant						1.000	0.908**	0.640**	-0.025	0.675**	0.640**
No. of bulblets per plant							1.000	0.634**	-0.145	0.671**	0.634**
Yield of bulb per plant(gm)								1.000	0.346**	0.996**	0.998**
Diameter of bulb(mm)									1.000	0.339**	0.346**
Yield of bulb and bulblets per plant (q/ha)										1.000	0.998**
Yield of bulb (q/ha)											1.000

*,** significant at 5% and 1% level, respectively

Table 2: Estimates of correlation coefficient for phenotypic level among different characters in tuberose.

Characters	Days taken to sprouting	Plant height (cm)	No. of leaves per plant	Length of longest leaf (cm)	Width of longest leaf (cm)	No. of sprouts per bulb	Days required for visibility of first spike	Days taken to opening of first flower	No. of florets per spike	Diameter of flower (cm)	No. of spikes per bulb	Yield of bulb (q/ha)
Days taken to sprouting	1.000	0.212	0.359**	0.226	0.203	0.250*	0.002	0.006	0.352**	0.084	0.329**	0.338**
Plant height (cm)		1.000	-0.208	0.995**	0.195	0.254*	0.578**	0.567**	0.324**	0.213	0.096	0.295*
No. of leaves per plant			1.000	-0.188	0.228	0.585**	-0.554**	-0.516**	0.120	0.074	0.292*	-0.091
Length of longest leaf (cm)				1.000	0.206	0.245*	0.571**	0.565**	0.337**	0.220	0.093	0.284*
Width of longest leaf (cm)					1.000	0.241	-0.157	-0.113	0.386**	-0.038	0.233	0.276*
No. of sprouts per bulb						1.000	-0.237	-0.166	0.064	0.197	0.462**	0.078
Days required for visibility of first spike							1.000	0.910**	0.280*	0.204	-0.210	0.341**
Days taken to opening of first flower								1.000	0.314*	0.208	-0.241	0.281*
No. of florets per spike									1.000	0.090	0.212	0.647**
Diameter of flower (cm)										1.000	-0.194	-0.163
No. of spikes per bulb											/1.000	0.483**
Yield of bulb (q/ha)												1.000

*,** significant at 5% and 1% level, respectively.

Table 2 (i): Estimates of correlation coefficient for phenotypic level among different characters in tuberose

Characters	Diameter of spike (mm)	Length of spike (cm)	Length of rachis (cm)	Longevity of spike	Vase life	No. of bulbs per plant	No. of bulblets per plant	Yield of bulb per plant(gm)	Diameter of bulb(mm)	Yield of bulb and bulblets per plant (q/ha)	Yield of bulb (q/ha)
Diameter of spike (mm)	1.000	0.350**	0.181	0.045	0.198	0.047	0.090	0.183	-0.015	0.185	0.183
Length of spike (cm)		1.000	0.594**	0.191	0.128	-0.005	0.116	-0.008	0.005	0.004	-0.008
Length of rachis (cm)			1.000	0.131	0.061	0.195	0.145	-0.092	-0.139	-0.079	-0.092
Longevity of spike				1.000	0.094	-0.161	-0.135	-0.090	-0.015	-0.085	-0.090
Vase life					1.000	-0.105	-0.069	0.116	0.235	0.115	0.116
No. of bulbs per plant						1.000	0.887**	0.613**	0.026	0.649**	0.613**
No. of bulblets per plant							1.000	0.606**	-0.045	0.646**	0.606**
Yield of bulb per plant(gm)								1.000	0.252*	0.995**	0.998**
Diameter of bulb(mm)									1.000	0.250*	0.252*
Yield of bulb and bulblets per plant (q/ha)										1.000	0.997**
Yield of bulb (q/ha)											1.000

*,** significant at 5% and 1% level, respectively

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