PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol 11(3): 785-791
https://doi.org/10.14719/pst.4017

HORIZON
e-Publishing Group

RESEARCH ARTICLE

Studies on correlation analysis, path analysis and genetic diversity in Rose (*Rosa* spp.)

Visalakshi M[1]*, R Muthulakshmi[1], M Ganga[1], S P Thamaraiselvi[1], S Ganesh[2] & S Vasanth[1]

[1]Horticultural College and Research Institute, TNAU, Coimbatore-641 003, Tamil Nadu, India

[2]SRM College of Agricultural Sciences, SRM Institute of Science and Technology, Chengalpattu, Tamil Nadu, India

OPEN ACCESS

ARTICLE HISTORY

Received: 13 May 2024
Accepted: 28 June 2024

Available online
Version 1.0 : 30 August 2024
Version 2.0 : 31 August 2024

Check for updates

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

CITE THIS ARTICLE

Visalakshi M, Muthulakshmi R, Ganga M, Thamaraiselvi SP, Ganesh S, Vasanth S. Studies on correlation analysis, path analysis and genetic diversity in Rosa (*Rosa spp*.). Plant Science Today. 2024; 11(3): 785-791. https://doi.org/10.14719/pst.4017

Abstract

This study conducted during 2019 to 2022 provides an in-depth analysis of varietal influence encompasses correlation analysis, path analysis and genetic divergence assessment to explore the intricate dynamics of plant and floral characteristics in *Rosa* spp. Correlation analysis reveals significant positive correlations between plant height and both north-south (NS) and east-west (EW) plant spread, indicating wider spreads in taller plants. Moreover, NS and EW plant spreads correlate positively with attributes like shoots, leaves and leaf area, suggesting enhanced vegetative growth. Path analysis uncovers direct and indirect effects among variables, with plant height emerging as a key influencer on leaf area and flower diameter. Notably, leaf area and leaf area index exhibit strong positive direct effects on plant height, highlighting their role in determining plant stature. Additionally, flower diameter positively impacts flower fresh weight and petal fresh weight, underscoring the relationship between flower size and weight. Genetic divergence analysis groups genotypes into distinct clusters based on similarities in characteristics, offering insights into their relationships and aiding in breeding processes. The study provides valuable insights into the complex dynamics governing plant and floral characteristics, enriching our understanding of their interactions within the ecosystem and offering potential implications for breeding and selection processes.

Keywords

Rose; correlation analysis; path analysis; genetic diversity; accessions

Introduction

Roses (*Rosa* spp.), members of the Rosaceae family, holds a preeminent status as the most beloved and economically significant flower crop globally. The etymology of the term "Rose" traces back to the Greek deity of love, 'Eros,' reflecting the enduring association between roses and expressions of affection. The genus *Rosa* aptly derives its name from the Greek word 'Rhedon,' signifying the exceptional fragrance that characterizes these blooms. Widely cultivated across the temperate and sub -tropical regions of the northern hemisphere *Rosa* spp. manifests as erect shrubs, climbers or trailers adorned with short prickles along their stems. It originates in the temperate zones of the northern hemisphere (1). Historical records document rose cultivation spanning millennia, with evidence of its presence in China, Western Asia and Northern Africa dating back 5000 years (2). Universally acclaimed as the "Queen of Flowers," the genus boasts an astonishing array of approximately 200 species and over 18000 cultivars, distinguished by diverse shapes, sizes, color and fragrances. Field flower roses find multifaceted utility in garland and veni crafting, essential oil extraction and religious offerings (3). Beyond their ornamental appeal, roses play a pivotal role in landscaping, where they embellish gardens as hedges, borders, rockeries, potted plants and specimen displays. Despite their ubiquitous presence, assessing the genetic diversity of roses remains a challenge. Traditional morphological and biochemical markers, while informative, often prove inconsistent due to environmental influences and overlapping traits (4). Molecular markers offer a more precise means of unravelling genetic variations and establishing intra- and interspecific relationships. However, the lack of comprehensive genetic diversity data for regionally adapted rose varieties in regions like Tamil Nadu, India, underscores the need for concerted efforts to expand the genetic reservoir and facilitate future breeding endeavour. Thus, leveraging molecular markers becomes imperative for characterizing germplasm, genetic diagnostics and charting phylogenetic relationships, paving the way for enhanced genetic improvement and sustainable rose cultivation practices.

Materials and Methods

Experimental Site:

The study was conducted at the Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University (TNAU), Coimbatore, India. The geographical coordinates of the experimental site are approximately 11° 02'N latitude and 76°93' E longitude, with an altitude of 355.68 meters above mean sea level.

Plant Materials:

Eleven varieties of *Rosa* spp. were utilized for the study, comprising 5 varieties sourced from the Indian Institute of Horticultural Research (IIHR), Bangalore and 6 locally collected varieties. The IIHR varieties included *Rosa rubiginosa* var. arka parimala, *Rosa rubiginosa* var. arka pride, *Rosa rubiginosa* var. arka savi, *Rosa rubiginosa* var. arka sinchana and *Rosa rubiginosa* var. arka swadesh, while the local varieties comprised *Rosa indica* - Seven Days Rose, *Rosa glauca* - Scent Pink, *Rosa rubiginosa* - Mirabel Red, *Rosa rugosa*- Roman Red, *Rosa foetida* - Roman Yellow and *Rosa xanthina* Lin - Mookuthi Yellow.

Experiment Details:

The field trial was established following a Randomized Block Design (RBD). Budded plants aged three months were transplanted into the field. Each of the 11 rose varieties constituted a separate treatment. The experiment comprised 3 replications, with 10 plants per replication. Uniform spacing of 1 m each by 1 m was maintained for planting all rose varieties.

Observations Recorded:

Various growth, physiological, yield, genetic and quality parameters were assessed across all evaluated rose varieties. These parameters encompassed plant height, plant spread in both North-South (NS) and East-West (EW) directions, shoot count, leaf count, leaf area, leaf area index, shoot girth, spadix measurement, thorn count, bud initiation, flower diameter, fresh weight of flowers and petals, stalk length and girth, number of flowers per sprout and per plant, number of petals per flower, petal dimensions and shelf life of flowers.

Statistical analysis

Correlation analysis among all the observed characters with yield was computed by adopting the method suggested (5). Path analysis which is helpful to figure out the direct and indirect relationships of variables on independent variables was determined by referring to the method (6, 7). Genetic divergence was assessed using the formula of D^2 analysis (8).

Results and Discussion

Mean performance

In Table 1, mean performance presents statistical data on various growth, physiological and yield parameters for a rose variety. It includes mean values, standard deviations, variances and coefficients of variation (CV %) for 22

Table 1. Mean performance for growth parameter, physiological parameters and yield parameters of rose variety.

	1	2	3	4	5	6	7	8	9	10	11
Mean	46.91	43.58	40.33	5.21	83.95	2756.67	0.28	2.52	41.28	6.82	17.67
Standard deviation	8.77	15.41	12.54	0.96	27.39	1492.17	0.15	0.13	7.30	3.30	3.16
Variance	76.84	237.50	157.23	0.92	750.32	2226.91	0.02	0.02	53.25	10.90	9.98
CV %	0.19	0.35	0.31	0.18	0.33	0.54	0.54	0.05	0.18	0.48	0.18

	12	13	14	15	16	17	18	19	20	21	22
Mean	5.30	2.45	1.70	3.44	1.21	4.39	6.82	44.91	2.59	2.35	3.45
Standard deviation	0.97	0.47	0.44	0.85	0.17	3.09	2.31	19.73	0.72	0.59	0.96
Variance	0.95	0.22	0.20	0.71	0.03	9.56	5.34	389.34	0.52	0.35	0.93
CV %	0.18	0.19	0.26	0.25	0.14	0.70	0.34	0.44	0.28	0.25	0.28

1-Plant height, 2- Plant Spread NS, 3- Plant Spread EW, 4- Shoots, 5- Leaves, 6- Leaf Area, 7- Leaf Area Index, 8- Shoot Girth, 9- Spadix, 10- Thorn , 11- Bud Initiation, 12- Flower Diameter, 13- Flower Fresh Weight, 14- Petal Fresh Weight, 15- Stalk Length, 16- Stalk Girth, 17- Number of flowers Per Sprout, 18- Number of flowers Per Plant, 19- Number of petals Per flower, 20- Petal Length, 21- Petal Breadth, 22- Shelf Life different measurements. The parameters cover a wide range of plant characteristics, from structural aspects like plant height and spread to flower-specific traits such as flower diameter and petal count. Some notable mean values include a plant height of 46.91 cm, an average of 5.21 shoots per plant and a leaf area of 2756.67 cm^2. The flowers have a mean diameter of 5.30 cm, with an average of 44.91 petals per flower. The data shows considerable variation across different parameters, as evidenced by the standard deviations and CV %. For instance, leaf area has the highest variance (2226.91) and CV % (0.54), indicating substantial variability in this trait among the sampled plants. This comprehensive dataset provides valuable insights into the growth and reproductive characteristics of this rose variety, which could be useful for cultivation, breeding programs or comparative studies with other rose varieties.

Correlation analysis

In Table 2, correlation analysis is a valuable statistical tool KAU graphs software that helps identify relationships between different variables. In this study, we conducted a correlation analysis on a wide range of variables related to plant characteristics, such as plant height, spread, shoots, leaves and various floral attributes (9). The purpose of this analysis is to investigate the strength and direction of relationships between these variables, which can provide insights into the underlying factors affecting plant growth and floral development and Fig. 1 shows the correlogram of character association (10).

Table 2. Correlation analysis for growth parameter, physiological parameters and yield parameters of rose variety.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	1	0.776**	0.814**	0.578	0.600	0.601	0.608*	0.371	-0.026	0.297	-0.545	0.458	0.545	0.206	0.68*	0.246	-0.16	0.194	0.248	0.215	0.321	0.47
2		1	0.959**	0.638*	0.74**	0.794**	0.799**	0.18	0.028	-0.193	-0.661*	0.339	0.401	0.176	0.471	0.223	-0.104	0.403	0.595	0.035	0.151	0.436
3			1	0.644*	0.744**	0.752**	0.759**	0.253	0.142	-0.097	-0.639*	0.258	0.437	0.216	0.477	0.291	0.048	0.45	0.549	-0.073	0.09	0.559
4				1	0.59	0.819**	0.827**	0.45	0.376	-0.174	-0.674*	0.386	0.651*	0.34	0.452	0.352	0.128	0.356	0.431	0.102	0.148	0.462
5					1	0.895**	0.888**	0.207	0.043	-0.207	-0.825**	0.448	0.611*	0.436	0.505	0.435	0.176	0.489	0.567	-0.076	0.027	0.633*
6						1	0.999**	0.236	0.115	-0.306	-0.743**	0.539	0.656*	0.465	0.54	0.503	-0.039	0.321	0.652*	0.106	0.151	0.499
7							1	0.242	0.126	-0.313	-0.738**	0.539	0.663*	0.464	0.547	0.494	-0.039	0.322	0.645*	0.111	0.158	0.505
8								1	0.308	0.515	-0.297	0.616*	0.742**	0.661*	0.608*	0.356	0.294	0.055	-0.275	0.491	0.662*	0.248
9									1	-0.098	-0.128	-0.085	0.356	0.373	0.17	-0.11	0.521	0.418	0.384	-0.221	-0.015	0.65*
10										1	0.249	0.252	0.295	0.265	0.24	0.285	-0.137	-0.415	-0.435	0.293	0.381	0.018
11											1	-0.277	-0.467	-0.145	-0.37	-0.042	-0.433	-0.77**	-0.362	0.132	0.05	-0.538
12												1	0.772**	0.761**	0.862**	0.466	-0.326	-0.267	0.033	0.827**	0.86**	0.094
13													1	0.841**	0.751**	0.557	0.078	0.066	0.226	0.383	0.534	0.611*
14														1	0.69*	0.644*	0.023	-0.157	0.227	0.467	0.625*	0.416
15															1	0.282	-0.138	-0.013	0.134	0.68*	0.797**	0.361
16																1	-0.21	-0.379	0.184	0.193	0.214	0.136
17																	1	0.769**	-0.102	-0.511	-0.345	0.45
18																		1	0.317	-0.547	-0.4	0.583
19																			1	-0.303	-0.224	0.561
20																				1	0.944**	-0.376
21																					1	-0.136
22																						1

1-Plant height, 2- Plant Spread NS, 3- Plant Spread EW, 4- Shoots, 5- Leaves, 6- Leaf Area, 7- Leaf Area Index, 8- Shoot Girth, 9- Spadix, 10- Thorn , 11- Bud Initiation, 12- Flower Diameter, 13- Flower Fresh Weight, 14- Petal Fresh Weight, 15- Stalk Length, 16- Stalk Girth, 17- Number of flowers Per Sprout, 18- Number of flowers Per Plant, 19- Number of petals Per flower, 20- Petal Length, 21- Petal Breadth, 22- Shelf Life

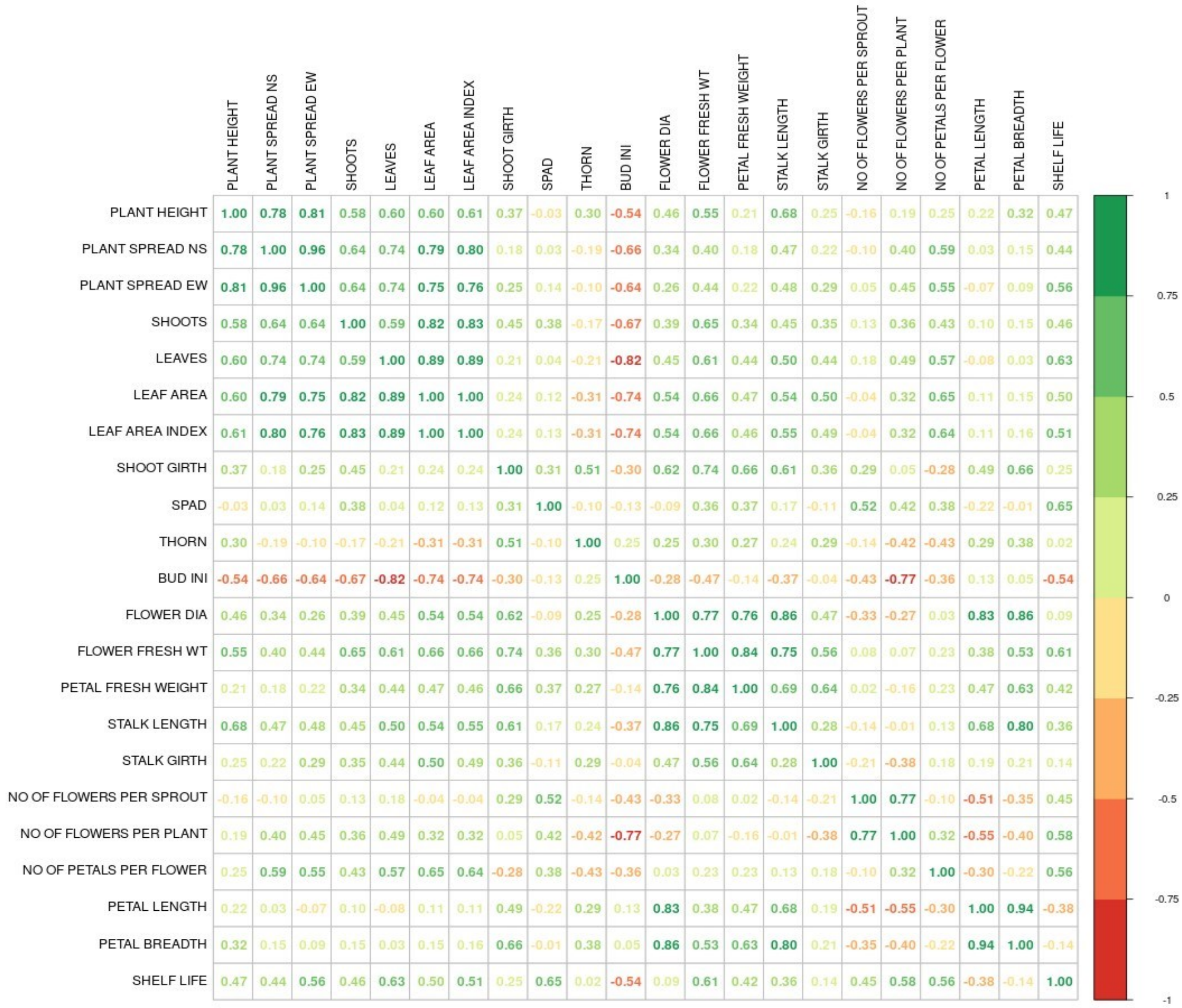

Fig. 1. Correlogram for character association.

The analysis revealed several noteworthy correlations among various plant characteristics. Firstly, there was a significant positive correlation observed between plant height and both north-south (NS) and east-west (EW) plant spread, suggesting taller plants tend to exhibit wider spreads in both directions due to increased lateral growth. Additionally, NS and EW plant spreads were highly correlated, indicating shared influencing factors. Greater NS plant spread correlated positively with attributes like shoots, leaves, leaf area and leaf area index, indicating enhanced vegetative growth. Shoots and leaves also exhibited positive correlations, supporting the notion that more shoots tend to accommodate more leaves. Moreover, larger leaf area and higher leaf area index were associated with increased vegetative and reproductive growth. Shoot girth correlated positively with plant height and various floral attributes, implying thicker shoots may contribute to taller plants and larger flowers. Larger flower diameter correlated positively with flower fresh weight, petal fresh weight and other floral attributes, suggesting a trend towards greater size-related characteristics. Conversely, attributes such as spadix, thorn count and bud initiation showed weak or negligible correlations with other variables, indicating independent influences. Furthermore, variables like number of flowers per sprout, number of flowers per plant and number of petals per flower displayed positive correlations, indicating interconnected growth patterns. Petal length exhibited a strong positive correlation with flower diameter, while petal breadth showed weak correlations, suggesting differential influences on petal dimensions. Lastly, shelf life showed no significant correlations with other variables, indicating independent determinants.

Path analysis

The path analysis conducted in Table 3 delves into the intricate network of relationships among various plant and floral attributes, shedding light on their interconnectedness within the system. Key findings unveil significant direct and indirect effects between different variables. Plant height emerges as a pivotal factor, positively influencing leaf area and flower diameter directly, while also indirectly affecting other characteristics such as shoot girth, petal length and shoot counts (11). Notably, leaf area and leaf area index exhibit strong positive direct effects on plant height, indicating their role in determining plant stature. Furthermore, positive direct effects between shoots and leaves suggest a symbiotic relationship, where higher shoot counts correlate with increased leaf counts. Flower diameter also plays a central role, positively impacting flower fresh weight and petal fresh weight, reinforcing the intuitive understanding of larger flowers bearing greater weight. Spadix, bud initiation, stalk length and number of flowers per plant also exhibit noteworthy direct effects on various

Table 3. Path analysis for growth parameter, physiological parameters and yield parameters of rose variety.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	**0.087**	0.176	-0.157	0.09	-0.08	0.508	-0.468	0.008	0.049	-0.006	0.201	0.395	0.215	-0.4	-0.002	0.022	-0.022	-0.127	-0.002	-0.033	0.293
2	0.075	**0.205**	-0.184	0.075	-0.085	0.533	-0.496	0.004	0.021	-0.001	0.185	0.228	0.108	-0.221	-0.002	0.004	-0.026	-0.252	0	-0.008	0.313
3	0.073	0.202	**-1.806**	0.082	-0.094	0.56	-0.519	0.003	0.022	-0.001	0.217	0.189	0.079	-0.19	-0.003	-0.028	-0.029	-0.276	0	0.001	0.364
4	0.082	0.16	-0.16	**0.096**	-0.102	0.68	-0.63	0.008	0.081	0.002	0.281	0.308	0.247	-0.255	-0.004	-0.106	-0.028	-0.25	-0.001	-0.009	0.384
5	0.062	0.157	-0.157	0.088	**-0.111**	0.622	-0.575	0.004	0.07	0.003	0.247	0.267	0.221	-0.239	-0.003	-0.083	-0.03	-0.329	0	-0.008	0.403
6	0.064	0.157	-0.15	0.093	-0.1	**0.695**	-0.644	0.004	0.06	0.003	0.222	0.296	0.228	-0.237	-0.004	0.013	-0.023	-0.359	-0.001	-0.011	0.326
7	0.063	0.158	-0.15	0.093	-0.1	0.695	**-0.644**	0.004	0.059	0.003	0.222	0.294	0.226	-0.236	-0.003	0.013	-0.024	-0.358	-0.001	-0.011	0.33
8	0.067	0.07	-0.047	0.071	-0.041	0.274	-0.244	**0.01**	0.057	-0.006	0.091	0.478	0.428	-0.389	-0.006	-0.021	0.001	0.102	-0.003	-0.045	0.106
9	0.025	0.025	-0.024	0.045	-0.046	0.245	-0.222	0.003	**0.171**	0.001	0.192	0.056	0.278	-0.128	0	-0.269	-0.025	-0.216	0.001	0.011	0.633
10	0.04	0.013	-0.015	-0.016	0.023	-0.179	0.162	0.005	-0.007	**-0.012**	-0.093	0.167	0.081	-0.211	-0.002	0.143	0.016	0.196	-0.001	-0.025	0.003
11	-0.058	-0.124	0.133	-0.088	0.091	-0.507	0.47	-0.003	-0.108	-0.004	**-0.304**	-0.156	-0.072	0.164	0	0.207	0.038	0.232	0	0	-0.392
12	0.067	0.091	-0.069	0.057	-0.058	0.4	-0.369	0.01	0.019	-0.004	0.092	**0.514**	0.374	-0.398	-0.004	0.114	0.002	-0.053	-0.003	-0.053	0.055
13	0.037	0.044	-0.029	0.047	-0.049	0.317	-0.291	0.009	0.095	-0.002	0.044	0.384	**0.501**	-0.311	-0.006	0.017	0.002	-0.149	-0.002	-0.032	0.239
14	0.077	0.1	-0.078	0.054	-0.059	0.364	-0.336	0.009	0.048	-0.006	0.11	0.452	0.345	**-0.452**	-0.002	0.061	-0.005	-0.057	-0.003	-0.048	0.224
15	0.024	0.055	-0.057	0.045	-0.041	0.284	-0.257	0.007	0.009	-0.003	-0.015	0.235	0.344	-0.129	**-0.009**	0.097	0.007	-0.133	-0.001	-0.011	0.037
16	-0.005	-0.002	-0.013	0.026	-0.024	-0.024	0.021	0.001	0.118	0.004	0.162	-0.151	-0.022	0.071	0.002	**-0.39**	-0.029	0.027	0.002	0.026	0.335
17	0.047	0.13	-0.135	0.066	-0.083	0.399	-0.374	0	0.105	0.005	0.283	-0.024	-0.025	-0.055	0.002	-0.28	**-0.041**	-0.255	0.002	0.022	0.505
18	0.022	0.104	-0.104	0.048	-0.074	0.504	-0.467	-0.002	0.075	0.005	0.142	0.055	0.151	-0.052	-0.002	0.022	-0.021	**-0.495**	0.001	0.016	0.397
19	0.044	0.026	0.003	0.014	-0.01	0.161	-0.148	0.007	-0.05	-0.004	-0.029	0.449	0.262	-0.337	-0.002	0.225	0.019	0.108	**-0.004**	-0.059	-0.217
20	0.049	0.027	0.005	0.014	-0.015	0.131	-0.12	0.008	-0.033	-0.005	-0.002	0.464	0.272	-0.371	-0.002	0.173	0.015	0.131	-0.004	**-0.059**	-0.159
21	0.039	0.097	-0.103	0.056	-0.068	0.346	-0.324	0.002	0.165	0	0.181	0.043	0.182	-0.155	0	-0.199	-0.031	-0.299	0.001	0.014	**0.656**

1-Plant height, 2- Plant Spread NS, 3- Plant Spread EW, 4- Shoots, 5- Leaves, 6- Leaf Area, 7- Leaf Area Index, 8- Shoot Girth, 9- Spadix, 10- Thorn, 11- Bud Initiation, 12- Flower Diameter, 13- Petal Fresh Weight, 14- Stalk Length, 15- Stalk Girth, 16- Number of flowers Per Sprout, 17- Number of flowers Per Plant, 18- Number of petals Per flower, 19- Petal Length, 20- Petal Breadth, 21- Shelf Life

attributes, elucidating their contributions to plant growth and floral development (12). Notably, the positive direct effect of shelf life on petal length underscores the importance of longevity in determining petal dimensions. Overall, this comprehensive analysis offers valuable insights into the intricate dynamics governing plant and floral characteristics, enriching our understanding of their interplay within the ecosystem Fig. 2.

Genetic divergence:

The D^2 analysis grouped in Table 4 the genotypes into 5 distinct clusters based on their similarities in various characteristics or attributes. Cluster I is comprised of a single genotype, "*Rosa rubiginosa* var. arka parimala." Cluster II includes "*Rosa rubiginosa* var. arka pride" and " *Rosa rubiginosa* var. arka swadesh," which share common characteristics that distinguish them from other genotypes. Cluster III encompasses a diverse set of genotypes, including "*Rosa rubiginosa* var. arka savi," " *Rosa rubiginosa* var. arka sinchana," " *Rosa rubiginosa* -Mirabel Red," "*Rosa rugosa* - Roman Red," and " *Rosa foetida* - Roman Yellow," suggesting that these genotypes have some commonalities in their attributes. Cluster IV consists of "Seven Days Rose" and "Scent Pink," implying that they share certain characteristics that set them apart from other genotypes (13). Finally, Cluster V comprises the genotype "*Rosa*

Fig. 2. Path diagram for rose traits.

Table 4. Composition of D^2 clusters for rose variety based on their different traits.

Clusters	Genotypes
Cluster I	*Rosa rubiginosa* var. arka parimala
Cluster II	*Rosa rubiginosa* var. arka parimala, *Rosa rubiginosa* var. arka swadesh
Cluster III	*Rosa rubiginosa* var. arka savi, *Rosa rubiginosa* var. arka sinchana, *Rosa rubiginosa* - Mirabel Red, *Rosa rugosa* - Roman Red, *Rosa foetida* - Roman Yellow Roman Yellow
Cluster IV	*Rosa indica* - Seven Days Rose, *Rosa glauca* - Scent Pink
Cluster V	*Rosa xanthina* Lin - Mookuthi Yellow

xanthina Lin - Mookuthi Yellow," which appears to be distinct from the other genotypes analysed. This clustering analysis provides valuable insights into the relationships and similarities among these genotypes, facilitating a better understanding of their characteristics and potentially aiding in breeding and selection processes. The Table 5 represents inter-cluster distances (the distances between different clusters) and intra-cluster distances (the distances within the same cluster) for a set of 5 clusters (labelled 1 to 5). The diagonal values represent the intra-cluster distances, which indicate the similarity or proximity of objects within the same cluster, with Cluster 1 having an intra-cluster distance of 0, Cluster 2 having 1726.54, Cluster 3 having 1780.81, Cluster 4 having 3652.02 and Cluster 5 having 0, suggesting that the objects within each cluster are relatively similar to each other. The off-diagonal values represent inter-cluster distances, indicating how different or distant objects from different clusters are from each other. For example, the distance between Cluster 1 and Cluster 2 is 1823.98, suggesting a moderate dissimilarity between these 2 clusters, whereas the distance between Cluster 4 and Cluster 5 is the highest at 1974.18, indicating they are relatively more similar compared to other inter-cluster distances. This analysis provides insights into the relationships and disparities between different clusters, which can be valuable for clustering and classification purposes (14). The Table 6 provides insights into the contribution of different characteristics (or variables) to the overall D^2 statistic, which is often used in multivariate analysis. Among the listed characteristics, flower diameter, petal fresh weight and petal length, all share the top rank with a contribution of 1.818182 % each. This indicates that these variables have a relatively low impact on the overall D^2 value. In contrast, number of petals per flower holds the third rank but contributes significantly more at 16.36364 %, suggesting its relatively higher importance in the D^2 value. The largest contribution is attributed to shelf life, which ranks fourth but contributes substantially at 72.72727 %, indicating that it has the most substantial impact on the D^2 statistic among all the listed characteristics (15). This analysis helps in understanding the relative importance of different variables in contributing to the D^2 value, which can be crucial in multivariate statistical analyses.

Table 5. Inter and intra cluster distance for rose accessions.

	1	2	3	4	5
1	**0**	1823.98	8698.20	1766.76	5275.61
2		**1726.54**	4423.80	7122.70	1442.77
3			**1780.81**	4715.27	7370.57
4				**3652.02**	1974.18
5					**0**

* Diagonal values indicate intra cluster distance

Table 6. Contribution of traits towards genetic divergence in rose accessions.

Sl. No.	Character	Rank	Contribution in percentage (%)
1	**Flower Diameter**	1	1.818182
2	**Petal Fresh Weight**	1	1.818182
3	**Stalk Girth**	3	5.454545
4	**Number of petals Per flower**	9	16.36364
5	**Petal Length**	1	1.818182
6	**Shelf Life**	40	72.72727

Conclusion

This study on *Rosa* spp. revealed significant correlations between plant morphological traits, with plant height strongly influencing leaf area and flower diameter. The genetic divergence analysis grouped genotypes into 5 distinct clusters, providing valuable insights for breeding programs. Notably, shelf life emerged as the most substantial contributor to genetic diversity, accounting for over 72 % of the variation in the D^2 statistic. These findings have important implications for rose breeding and cultivation, offering potential for developing varieties with enhanced ornamental and commercial value. Future research directions include targeted breeding programs leveraging identified correlations, further investigation into the genetic basis of shelf life and expansion of the study to include a wider range of rose varieties and wild species. Integration of molecular marker techniques with morphological data could provide a more comprehensive understanding of rose genetics and evolution, potentially leading to innovations in the ornamental plant industry and contributing to sustainable horticultural practices.

Acknowledgements

The author greatly acknowledges the Department of Floriculture and Landscape Architecture, TNAU, Coimbatore for extending the space and funding to carry out the research. I wish to extend my thanks to Head of the Department and Committee Members for their unwavering support.

Authors' contributions

MV designed and formulated the study, facilitate to obtain funds and approved the final manuscript. **RM** carried out the experiment, recorded observations and analysed the data. **MG** helped in formulating the concept and provided funds to carry out the research. **SPT** supported in editing the manuscript. **SG** helped in summarizing and revising the manuscript. **SV** done the statistical analysis, correlogram and revised manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) not used any generative AI and AI-assisted technologies while writing process.

References

1. Nybom H, Werlemark G. Realizing the potential of health-promoting rosehips from dogroses (*Rosa* sect. *Caninae*). Current Bioactive Compounds. 2017;13(1):3-17. https://doi.org/10.2174/1573407212666160607090635
2. Gudin S. Rose breeding technologies; In: III International Symposium on Rose Research and Cultivation; 2000. 547:23-33. https://doi.org/10.17660/ActaHortic.2001.547.2
3. Amita VB, Urfi F, Devi S. Varietal evaluation of different floribunda rose (Hybrid teas x Polyanthas) under Prayagraj agro -climatic condition. International Journal of Current Microbiology and Applied Sciences. 2021;10(1):3028-35. https://doi.org/10.20546/ijcmas.2021.1001.352
4. Lewis WH. A monograph of the genus *Rosa* in North America East of the Rocky Mountains. University of Virginia; 1957. https://doi.org/10.11646/phytotaxa.567.1.7
5. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soybeans. https://doi.org/10.2134/agronj1955.00021962004700070009x
6. Wright S. Correlation and causation. Journal of agricultural research. 1921;20(7):557.
7. Dewey DR, Lu KA. Correlation and path-coefficient analysis of components of crested wheatgrass seed production 1. Agronomy Journal. 1959;51(9):515-18. https://doi.org/10.2134/agronj1959.00021962005100090002x
8. Chandra MP. On the generalised distance in statistics. In: Proceedings of the National Institute of Sciences of India; 1936.49-55.
9. Raj RL, Misra HC, Dohare SR. Correlation and path-coefficient studies in *Gladiolus* over different environments. Journal of Ornamental Horticulture. 1998;1(1):26-31.
10. Prakash A, Kumar M, Singh C, Kumar A, Badal DS, Singh S. Correlation and path analysis studies in chrysanthemum (*Dendranthema grandiflora* TZVELEV). Journal of Pharmacognosy and Phytochemistry. 2018;7(2):3890-93.
11. Sewaniya P. Study on variability, correlation and path analysis in HT rose varieties at Malwa plateau (Doctoral dissertation, JNKVV).
12. Sivasubramaniam S, Madhava Menon P. Path analysis of yield components in rice. 1973; https://doi:10.11648/j.aff.20170606.12
13. Kumar S, Kumar M, Yadav HK, Sharma S. Genetic diversity and population structure analysis of chrysanthemum (*Dendranthema grandiflora* Tzvelev) germplasm based on RAPD markers. Journal of Environmental Biology. 2017;38(3):457. https://doi:10.22438/jeb/38/3/MS-201
14. Rai H, Raju DV, MB AK, Janakiram T, Namita N, Krishnan SG, Rana JC. Characterization and analysis of genetic diversity among different species of rose (*Rosa* species) using morphological and molecular markers. The Indian Journal of Agricultural Sciences. 2015;85(2):240-45. https://doi.org/10.56093/ijas.v85i2.46518
15. Azeem S, Khan AI, Awan FS, Riaz A, Bahadur S. Genetic diversity of rose germplasm in Pakistan characterized by random amplified polymorphic DNA (RAPD) markers. African Journal of Biotechnology. 2012;11(47):10650-54. https://doi.org/10.1007/s13237-018-0238-7