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Path analysis in *Hibiscus rosa-sinensis* L.

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Abstract
The experiment was conducted in a randomized block design with two replications. Each plot contains six plants spaced at 1.8 X 1.0 m at Modibaug, Horticulture section, College of Agriculture, Shivaji nagar, Pune -5 (M.S) during year 2015-2017. The experimental material consisted of 20 genetically diverse genotypes of *Hibiscus rosa-sinensis* L. obtained from different sources.
Among the 17 characters studied, number of secondary branches recorded highest positive direct effect on number of flowers per plant followed by number of node at which first flower appeared, style length, East-West plant spread and number of petals per flower. Whereas the characters like length of flower bud, plant height, number of primary branches were recorded relatively low and positive direct effect on number of flowers per plant. It can be concluded that the selection for number of primary branches, East-West plant spread number of node at which first flower appeared and longevity of flower would be helpful and effective in improvement of number of flowers per plant in Hibiscus *rosa-sinensis* L.

Keywords: Direct effect, indirect effect, genotypes and Hibiscus

Introduction

Hibiscus rosa-sinensis L. commonly known as china rose or Jaswandand is one of the important cut flower produced in all states of India. Hibiscus is one of the beautiful shrub grown in tropical and subtropical region of the country and widely grown in our Indian gardens as it is easy for cultivation and produced flowers almost throughout the year. The flowers are in many colours including white Red, Pink, Yellow, Magenta, Orange etc. It is grown in countries like Hawaii, USA. (Florida), Sri Lanka and India reported that Hibiscus is cultivated widely in Hawaii which has it as state flower. Hawaii has the reputation of possessing the world's richest collection and being the center for evolving new varieties. In Maharashtra it is generally grown in every kitchen garden either in soil or in pots. Numbers of local types (different colours and shapes) are available in country with different bloom period. While reviewing the breeding aspects of this crop, it was observed that very limited systematic attempts were made to improve this crop indicating the need of developing new varieties with desirable attributes. This flower is marketed on number basis, hence we are interested to have cultivars with more flower production; long blooming period and more longevity. Path coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation coefficients into direct and indirect effects.

In the present investigation, Path analysis was worked out by following Dewey and Lu (1959) [1] to estimate the magnitude and direction of direct and indirect effects of yield and yield contributing characters. Path analysis provides the information about characters and their relative importance. Correlation coefficients along with path effects provide more reliable information which can be effectively used in various crop improvement programmes. If the correlation between a casual factor and direct effect is more or less of equal magnitude, it explaining the true and perfect correlation between the traits and direct selection through there traits will be rewarding. However, if the correlation coefficient is positive and direct effect is negative or very negligible, the indirect casual factors are to be considered in simultaneous selection.

Materials and Methods

The experiment was conducted in a randomized block design with two replications.

Each plot contains six plants spaced at 1.8 X 1.0 m at Modibaug, Horticulture section, College of Agriculture, Shivajinagar, Pune -5 (M.S) during year 2015-2017. The experimental material consisted of 20 genetically diverse genotypes of *Hibiscus Rosa-sinensis* L. obtained from different sources. All cultural practices and application of fertilizers were common for all the Varieties. The usual cultural practices like weeding, irrigation and plant protection measures were followed as and when required during the growth period of the crop. For Three plants per treatment were used for recording the weight of flower (gm), pedicel length (mm), style length (mm), weight of flowers per plant (g), days for initiation of flower bud from planting, longevity of flower, diameter of flower (cm), days to anthesis, length of flower bud (cm), number of nodes at which first flower appeared, number of petals / flower, plant height (cm) at 360 dap, plant spread (EW) in cm, plant spread (NS) in cm, number of primary branches / plant, number of secondary branches per plant and number of flowers per plant. The direct and indirect influence of components of flower yield path coefficient analysis was done as per Dewey and Lu (1959) [1].

Results and Discussions

The direct and indirect contributions of each character towards number of flowers per plant are presented in Table 1. The genotypic correlation coefficients are important and considered for path analysis. Among the sixteen characters studied, number of secondary branches (1.398) recorded highest positive direct effect on number of flowers per plant followed by number of node at which first flower appeared (1.288), style length (0.758) East-West plant spread (0.750) and number of petals per flower (0.707). The characters like length of flower bud (0.393), plant height (0.323), number of primary branches (0.171) were recorded relatively low and positive direct effect on number of flowers per plant. Least positive direct effect (0.017) was recorded by longevity of flower. The similar results was reported by Srivastava *et al.* (1988) [6] for Jasmine.

The character *viz.* days to anthesis (-0.524), diameter of flower (-0.462); weight of flower (-0.380); weight of flowers per plant (-0.376), pedicel length (-0.078), days for initiation of flower budfrom planting (-1.759) and North-South plant spread (-2.823), were recording negative direct effect on number of flowers per plant. The characters recording positive but comparatively low direct effect on number of flowers per plants were plant height (0.323), length of flower bud (0.393) and number of primary branches per plant (0.171).

Looking to the indirect effect of various characters it was observed that the traits longevity of flower (0.347), node number at which first flower appeared (0.545), East-West plant spread (0.337) and number of primary branches (0.343) had significant and positive correlation with number of flowers per plant which was mainly due to indirect effects of node number on which first flower appeared, East-West plant spread, number of primary branches and longevity of flower.

Number of node at which first flower appeared (0.545) had significant and positive correlation with number of flowers per plant through its in direct effects via East-West plant spread (0.989), plant height (0.971), North-South plant spread (0.943), pedicel length (0.721), style length (0.562), number of days for initiation of flower bud from planting(0.765) and number of primary branches(0.424), where as negative indirect effects of weight of flower (-0.430), days to anthesis (-0.432), number of petals per flower (-0.390), weight of flowers (-0.391) and longevity of flower(-0.209).

East-West plant spread (0.337) exhibited significant and positive correlation with number of flower per plant through it's indirect effect via North-South plant spread (0.729), number of primary branches (0.586), number of secondary branches per plant (0.218), plant height (0.732), number of node at which first flower appeared (0.575), length of flower bud (0.171), days for initiation of flower bud from planting (0.191), style length (0.210), pedicel length (0.435) and longevity of flower (0.053). The similar results were reported by Kanwar *et al.* (2009) [2] for French Marigold, Magar *et al.* (2010) [3] for Gerbera and Nair *et al.* (2003) [4] for gerbera. The negative indirect effects have been reported by weight of flower per plant (-0.105), diameter of flower (-0.109), days to anthesis (-0.281) and number of petals per flower (-0.064).

Number of primary branches per plant (0.343) recorded significant and positive correlation with number of flowers per plant, through its indirect and positive effect via all the parameters studied except weight of flower (-0.014), days to initiation of flower bud from planting (-0.040), diameter of flower (-0.084), days to anthesis (-0.039) and length of flower bud (-0.039) were contributed negatively. The similar results was reported by Nair *et al.* (2003) [4].

Longevity of flower (0.347) was found significantly and positively correlated with number of flowers per plant through its indirect effects of all the characters studied except style length (-0.003), days for initiation of flower bud from planting (-0.005), diameter of flower (-0.001), length of flower bud (-0.007) and number of node at which first flower appeared (-0.003), which were contributed with negative indirect effects.

Table 1: Direct (diagonal) and indirect (off diagonal) effects of 16 characters in 20 genotypes of *Hibiscus rosa-sinensis* L.

	CH-1	CH-2	CH-3	CH-4	CH-5	CH-6	CH-7	CH-8	CH-9	CH-10	CH-11	CH-12	CH-13	CH-14	CH-15	CH-16	CH-17
CH-1	(-) 0.380	(-) 0.099	(-) 0.070	(-) 0.346	0.104	(-) 0.228	(-) 0.169	(-) 0.148	(-) 0.013	0.115	(-) 0.290	0.048	0.072	0.058	0.030	(-) 0.041	0.107
CH- 2	(-) 0.020	(-) 0.078	(-) 0.047	(-) 0.026	0.008	(-) 0.025	(-) 0.001	0.030	0.002	(-) 0.044	(-) 0.021	(-) 0.047	(-) 0.045	(-) 0.052	(-) 0.050	0.011	-0.146
CH-3	0.140	0.452	0.758	0.158	0.168	(-) 0.129	0.320	(-) 0.295	0.300	0.331	(-) 0.095	0.198	0.213	0.301	0.014	0.042	0.056
CH- 4	(-) 0.342	(-) 0.126	(-) 0.079	(-) 0.376	0.164	(-) 0.192	(-) 0.104	(-) 0.082	(-) 0.001	0.125	(-) 0.258	0.011	0.053	0.022	(-) 0.006	(-) 0.086	0.302
CH- 5	0.483	0.178	(-) 0.390	0.765	(-) 1.759	0.542	(-) 0.386	0.322	(-) 0.637	(-) 1.044	0.399	(-) 0.319	(-) 0.447	(-) 0.416	0.414	(-) 0.612	0.228
CH- 6	0.010	0.005	(-) 0.003	0.009	(-) 0.005	0.017	(-) 0.001	0.008	(-) 0.007	(-) 0.003	0.014	0.003	0.001	0.001	0.007	0.001	0.347*
CH- 7	(-) 0.206	(-) 0.004	(-) 0.196	(-) 0.128	(-) 0.102	0.027	(-) 0.462	(-) 0.145	(-) 0.255	(-) 0.023	(-) 0.034	0.082	0.067	0.066	0.226	(-) 0.093	0.080

CH- 8	(-) 0.204	0.202	0.204	(-) 0.114	0.096	(-) 0.252	(-) 0.164	(-) 0.524	(-) 0.106	0.176	(-) 0.242	0.181	0.196	0.242	0.120	(-) 0.012	0.201
CH- 9	0.013	(-) 0.012	0.155	0.001	0.142	(-) 0.158	0.217	0.079	0.393	0.161	(-) 0.111	0.047	0.090	0.119	(-) 0.087	0.214	0.022
CH- 10	(-) 0.391	0.721	0.562	(-) 0.430	0.765	(-) 0.209	0.065	(-) 0.432	0.528	1.288	(-) 0.390	0.971	0.989	0.943	0.424	0.053	0.545**
CH- 11	0.540	0.193	(-) 0.089	0.484	(-) 0.160	0.588	0.054	0.326	(-) 0.200	(-) 0.214	0.707	0.027	(-) 0.060	(-) 0.044	0.166	0.060	0.041
CH- 12	(-) 0.041	0.194	0.084	(-) 0.009	0.059	0.051	(-) 0.057	(-) 0.112	0.039	0.243	0.012	0.323	0.315	0.317	0.266	0.109	0.084
CH- 13	(-) 0.142	0.435	0.210	(-) 0.105	0.191	0.053	(-) 0.109	(-) 0.281	0.171	0.575	(-) 0.064	0.732	0.750	0.729	0.586	0.218	0.337*
CH- 14	0.431	(-) 1.888	(-) 1.121	0.164	(-) 0.667	(-) 0.198	0.400	1.305	(-) 0.855	(-) 2.064	0.177	(-) 2.771	(-) 2.744	(-) 2.823	(-) 2.149	(-) 0.969	0.291
CH- 15	(-) 0.014	0.110	0.003	0.003	(-) 0.040	0.066	(-) 0.084	(-) 0.039	(-) 0.039	0.056	0.040	0.141	0.140	0.130	0.171	0.006	0.343*
CH- 16	0.150	(-) 0.205	0.078	0.318	0.485	0.112	0.281	0.031	0.762	0.058	0.118	0.471	0.406	0.480	0.052	1.398	0.037

CH-1: Weight of flower (g); CH-2: Pedicel length (mm); CH-3: Style length (mm); CH-4: Weight of flowers/pl (g)., CH-5: Days for initiation of flower bud from planting; CH-6: Longevity of flower; CH-7: Diameter of flower (cm); CH-8: Days to anthesis; CH-9: Length of flower bud (cm); CH-10: Number of nodes at which first flower appeared; CH-11: Number of petals / flower; CH-12: Plant height (cm) at 360 DAP; CH-13: Plant spread (EW) in cm; CH-14: Plant spread (NS) in cm; CH-15: Number of primary branches / plant; CH-16: Number of secondary branches per plant and CH-17: number of flowers per plant.

Conclusion

Among the sixteen characters studied, number of secondary branches recorded highest positive direct effect on number of flowers per plant followed by number of node at which first flower appeared, style length, East-West plant spread and number of petals per flower. Whereas the characters like length of flower bud, plant height, number of primary branches were recorded relatively low and positive direct effect on number of flowers per plant. However, least positive direct effect was recorded by longevity of flower. The character *viz.* days to anthesis, diameter of flower, weight of flower, weight of flowers per plant, pedicel length, days for initiation of flower bud from planting and North-South plant spread, were recording negative direct effect on number of flowers per plant. It can be therefore concluded that the selection for number of primary branches, East-West plant spread, number of node at which first flower appeared and longevity of flower would be helpful and effective in improvement of number of flowers per plant in hibiscus.

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