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Correlation and Path Coefficient Analysis of Yield and Yield Contributing Characters in Stylosanthes species

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Abstract

The investigation correlation and path coefficient analysis of yield and yield contributing characters in *Stylosanthes* species was undertaken to study the magnitude of genetic variability, character associations and direct and indirect contribution of various components towards green forage yield. The ten observations were recorded on green forage yield and yield contributing characters *viz*., plant height (cm), plant spread (cm), number of primary branches plant^{-1}, leaf length (cm), leaf breadth (cm), length of leaf sheath (cm), leaf to stem ratio, green forage yield plant^{-1} (g), dry matter yield plant^{-1} (g), and crude protein yield plant^{-1} (g). Plant spread, dry matter yield plant^{-1}, plant height, crude protein yield plant^{-1}, number of primary branches plant^{-1}, length of leaf sheath and leaf length had significant positive correlation with green forage yield plant^{-1} indicating their importance for indirect selection in green forage improvement programme. Path analysis studies revealed that plant spread, plant height, number of primary branches per plant, length of leaf sheath and crude protein yield had direct positive effect for the contribution to green forage yield plant^{-1}.

Key words : Stylosanthes, correlation, path analysis, yield.

Stylosanthes popularly known as stylo, is an erect growing perennial forage legume native of Brazil. It grows 0.6 to 1.8 m tall. Stems are coarse and hairy becoming woody with age. Leaves are trifoliate with leaflets long; rather narrow varying in size, colour and hairiness. Flower which are borne in terminal clusters are small, yellow or orange. Pods are single seeded, seeds are yellowish brown, rather kidney shaped and larger than seeds of Lucerne. Seed count is 250 per g, chromosome number (2n) is 20 (Hopkinson and Walker, 1984). Improvement of feed quality and quantity has been major thrust and the genus *Stylosanthes* has been used for this purpose. *Stylosanthes* is also being successfully integrated in crop/pasture production system. The most important attributes of successful Stylosanthes genotypes used as pasture or lay in tropical America are resistance to disease, high seed yield and adaptation to infertile soils (Ferguson *et al.*, 1989).

Correlation coefficient is a statistical measure, which is used to find out the degree (strength) and direction of relationship between two or more variable. In the present investigation, correlation coefficient analysis measure the mutual relationship between various plant traits and to determine the component trait on which selection can be used for genetic improvement in yield while selecting the suitable plant type. In the present investigation the genotypic and phenotypic correlation coefficient of different traits with green forage yield per plant and their relationship among themselves.

Correlation coefficient values do not reveal the real association pattern of the independent variables with the dependent one. This alone is not adequate to interpret the cause and effect relationships among the traits and ultimately with green forage yield. Path coefficient analysis on the other hand is an efficient statistical technique specially designed to partition the

correlation coefficient into direct and indirect effect, provides the information on actual contribution of a trait on the yield.

Material and methods

The experiment was laid out in randomized block design (RBD) with two replications having forty three genotypes at Grass Breeding Scheme, Mahatma Phule Krishi Vidyapeeth, Rahuri- 413 722 (M.S.). The experimental material consisted of forty three genotypes of *Stylosanthes* including check Phule Kranti which were provided by Grass Breeding Scheme, MPKV, Rahuri. Genotypic and phenotypic coefficients of correlation were estimated as described by Singh and Chaudhary (1977) and Johnson *et al*. (1955). Direct and indirect effects were estimated by the path coefficient analysis as suggested by Dewey and Lu (1959) genotypic level.

Results and discussion

Association of green forage yield with other characters : The characters *viz*., plant height (0.842, 0.880), plant spread (0.993, 0.984), number of primary branches (0.597, 0.650), leaf length (0.356, 0.390), length of leaf sheath (0.441, 0.557), dry matter yield (0.903, 0.897) and crude protein yield (0.747, 0.742) showed highly significant positive association with green forage yield at both genotypic and phenotypic levels, respectively. Leaf breadth (-0.127) had negative correlation with green forage yield at genotypic level and positive but non significant correlation (0.141) with green forage yield at phenotypic level. Leaf to stem ratio (-0.101, -0.137) had negative correlation with green forage yield at both genotypic and phenotypic levels, respectively shown in the Table 1.

Yadav *et al.* (1974) also reported in *Penisetum pedicellateum* revealed that there was significant positive correlation between plant height and green forage yield. Other workers additionally discovered significant positive correlation with green forage yield viz., Thakral and Jatasara (2014) of plant height; Gore et al. (2016) of plant height and number of leaves in marvel grass; Sandya et al. (2019) and Kumar et al. (2020) for dry matter yield in sewan grass; Udendra et al. (2020) in grasses species for number of leaves and plant height and Bhosale et al. (2021) of characters plant height, leaf length and dry matter yield in *Cenchrus ciliari* which confirms the present findings.

In present study for most of the characters, genotypic association was greater than corresponding phenotypic correlation, indicated that these characters are useful in yield improvement.

Association among forage yield component traits

Plant height (cm) : Plant height recorded significant positive correlation with plant spread (0.862, 0.865), dry matter yield (0.854, 0.848), crude protein yield (0.630, 0.657), length of leaf sheath (0.401, 0.574), number of primary branches (0.296, 0.541) and leaf length (0.296, 0.344) at both genotypic and phenotypic levels, respectively. Leaf to stem ratio had positive (0.036) non significant and negative (-0.045) correlation at genotypic and phenotypic levels, respectively and leaf breadth had negative (-0.180) and positive (0.134) non significant correlation at genotypic and phenotypic levels, respectively. This result indicated that selection for increased plant height will be rewarded with plant spread, number of primary branches, green forage yield, dry matter yield and crude protein yield.

Plant spread (cm) : Plant spread recorded significant positive correlation with dry matter yield (0.908, 0.896), crude protein yield (0.727, 0.725), number of primary branches per plant

(0.648, 0.632), length of leaf sheath (0.483, 0.543) and leaf length (0.338, 0.375) at both genotypic and phenotypic levels, respectively. Leaf breadth had negative (-0.091) and positive (0.121) non significant correlation at genotypic and phenotypic levels, respectively However, leaf to stem ratio had negative non significant correlation (-0.122, -0.141) at both genotypic and phenotypic levels, respectively.

Number of primary branches per plant: Number of primary branches per plant recorded significant positive correlation with dry matter yield (0.504, 0.581) and leaf length (0.349, 0.331) at both genotypic and phenotypic levels, respectively. It had positive but non significant genotypic correlation and significant positive phenotypic correlation with crude protein yield (0.206, 0.390) and length of leaf sheath (0.002, 0.397). However, it was negatively correlated with leaf to stem ratio (-0.143, -0.120) at genotypic and phenotypic levels, respectively.

Leaf length (cm) : Leaf length recorded significant positive correlation with dry matter yield (0.267, 0.310) and length of leaf sheath (0.247, 0.287) at genotypic and phenotypic levels, respectively. It had positive but non significant correlation with crude protein yield (0.100, 0.175) and leaf breadth (0.086, 0.114). However, negative non significant correlation with leaf to stem ratio (-0.023, -0.047) at genotypic and phenotypic levels, respectively.

Leaf breadth (cm) : Leaf breadth had significant positive correlation with leaf to stem ratio (0.445, 0.253) at genotypic and phenotypic levels, respectively. Crude protein yield had positive but non significant correlation (0.153) at genotypic level and positive significant correlation (0.264). It had negative correlation with length of leaf sheath (-0.583, -0.075), whereas, negative genotypic correlation and positive phenotypic correlation with dry matter yield (-0.158, 0.091).

Length of leaf sheath (cm) : Length of leaf sheath recorded positive significant correlation with dry matter yield (0.551, 0.577) and crude protein yield (0.308, 0.383) at genotypic and phenotypic levels, respectively. However, leaf to stem ratio had positive

Table 1. Estimates of genotypic (above diagonal) and phenotypic correlation coefficients (below diagonal) of yield contributing characters with green forage yield in forty three *Stylosanthes* genotypes

Characters	Plant height (cm)	Plant spread (cm)	No. of primary branches/ lant^{-1}	Leaf length (cm)	Leaf breadth (cm)	Length of leaf sheath (cm)	Leaf to stem ratio	Dry matter yield plant^{-1} (g)	Crude protein yield plant^{-1} (g)	Green forage yield plant^{-1} (g)
Plant height (cm)	1.000	0.862**	0.296**	0.296**	-0.180	0.401**	0.036	0.854**	0.630**	0.842**
Plant spread (cm)	0.865**	1.000	0.648**	0.338**	-0.091	0.483**	-0.122	0.908**	0.727**	0.993**
No. of primary branches plant^{-1}	0.541**	0.632**	1.000	0.349**	-0.216	0.002	-0.143	0.504**	0.206	0.597**
Leaf length (cm)	0.344**	0.375**	0.331**	1.000	0.044	0.247*	-0.023	0.267*	0.100	0.356**
Leaf breadth (cm)	0.134	0.121	0.199	0.114	1.000	-0.583	0.445**	-0.158	0.153	-0.127
Length of leaf sheath (cm)	0.574**	0.543**	0.397**	0.287*	-0.075	1.000	0.253*	0.551**	0.308**	0.441**
Leaf to stem ratio	-0.045	-0.141	-0.120	-0.047	0.253**	0.107	1.000	-0.022	0.004	-0.101
Dry matter yield plant^{-1} (g)	0.848**	0.896**	0.581**	0.310**	0.091	0.577**	-0.042	1.000	0.707**	0.903**
Crude protein yield plant^{-1} (g)	0.657**	0.725**	0.390**	0.175	0.264*	0.383**	-0.017	0.733**	1.000	0.747**
Green forage yield plant^{-1} (g)	0.880**	0.984**	0.650**	0.390**	0.141	0.557**	-0.137	0.897**	0.742**	1.000

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

significant (0.253) and positive non significant (0.107) at genotypic and phenotypic levels, respectively.

Leaf to stem ratio : Leaf to stem ratio recorded positive non significant genotypic correlation and negative non significant phenotypic correlation with crude protein yield (0.004, -0.017), respectively. It had negative non significant correlation with dry matter yield (-0.022, -0.042) at both genotypic and phenotypic levels, respectively.

Dry matter yield/plant (g) : Dry matter yield recorded highly significant positive correlation with crude protein yield (0.707, 0.733) at both genotypic and phenotypic levels, respectively.

Direct effects : From the Table 2, it is evident that, the plant spread expressed highest positive direct effect (0.572) on green forage yield then came plant height (0.219), number of primary branches (0.163), length of leaf sheath (0.138), crude protein yield (0.132) and leaf breadth (0.095). On the other hand, leaf to stem ratio revealed highest negative direct effect (-0.094) on green forage yield followed by dry matter yield (-0.041) and leaf length (-0.001).

Patil and Jadhav (1994) observed positive direct effect of leaf breadth on green fodder yield in pearl millet and napier hybrids; Sukanya (1998) of leaf breadth in guinea grass; Bhosale *et al*. (2021) of plant height in Cenchrus ciliaris.

Indirect effect of different independent traits on green forage yield

Plant height (cm) : Plant height exhibited positive direct effect of magnitude (0.219) and its association with green forage yield was highly significant and positive (0.842). It was due to positive indirect effect via plant spread (0.493), crude protein yield (0.083), length of leaf sheath (0.005) and no. of primary branches (0.048).

Plant spread : Plant spread exhibited positive direct effect (0.572) and it was highly significant and positively associated with green forage yield (0.993). It was due to positive indirect effect of plant height (0.189), number of primary branches (0.105), crude protein yield (0.096), length of leaf sheath (0.067) and leaf to stem ratio (0.012).

Table 2. Estimates genotypic direct (diagonal) and indirect effects (above and below diagonal) of component characters on green forage yield per plant (g) in forty three genotypes of *Stylosanthes* Genotypic correlation with

Characters	Plant height (cm)	Plant spread (cm)	No. of primary branches plant^{-1}	Leaf length (cm)	Leaf breadth (cm)	Length of leaf sheath (cm)	Leaf to stem ratio	Dry matter yield plant^{-1} (g)	Crude protein yield plant^{-1} (g)	Green forage yield plant (g)
Plant height (cm)	0.219	0.493	0.048	0.000	-0.017	0.055	-0.003	-0.035	0.083	0.842**
Plant spread (cm)	0.189	0.572	0.105	-0.001	-0.009	0.067	0.012	-0.037	0.096	0.993**
No. of primary branches plant^{-1}	0.065	0.371	0.163	-0.001	-0.021	0.000	0.013	-0.021	0.027	0.597**
Leaf length (cm)	0.065	0.194	0.057	-0.001	0.004	0.034	0.002	-0.011	0.013	0.356**
Leaf breadth (cm)	-0.040	-0.052	-0.035	0.000	0.095	-0.080	-0.042	0.006	0.020	-0.127
Length of leaf sheath (cm)	0.088	0.276	0.000	0.000	-0.055	0.138	-0.024	-0.023	0.041	0.441**
Leaf to stem ratio	0.008	-0.070	-0.023	0.000	0.042	0.035	-0.094	0.001	0.001	-0.101
Dry matter yield plant^{-1} (g)	0.187	0.520	0.082	0.000	-0.015	0.076	0.002	-0.041	0.093	0.903**
Crude protein yield plant^{-1} (g)	0.138	0.416	0.034	0.000	0.015	0.042	0.000	-0.029	0.132	0.747**
Residual effect (R) = 0.177										

** significant at 1% level of significance.

Number of primary branches per plant: Number of primary branches per plant exhibited positive direct effect of (0.163) and it had significant positive association with green forage yield (0.597). This was due to low positive indirect effects of plant spread (0.371), plant height (0.065), crude protein yield (0.027) and leaf to stem ratio (0.013).

Leaf length (cm) : Leaf length exhibited negligible negative direct effect of magnitude (-0.001) but its correlation was positive and highly significant with green forage yield (0.356). It was due to high indirect effects through plant spread (0.194) followed by plant height (0.065), number of primary branches (0.057), length of leaf sheath (0.034), crude protein yield (0.013), leaf breadth (0.004) and leaf to stem ratio (0.002).

Leaf breadth (cm) : Leaf breadth exhibited positive direct effect of magnitude (0.095) and it was negatively associated with green forage yield (-0.127). This was due to showed negative indirect effect through length of leaf sheath (-0.080), plant spread (-0.052), leaf to stem ratio (-0.042), plant height (-0.040) and number of primary branches (-0.035).

Length of leaf sheath (cm) : Length of leaf sheath had positive direct effect (0.138) on green forage yield and also shows significant positive association with green forage yield (0.441). This was due to positive indirect effects of plant spread (0.276), plant height (0.088) and crude protein yield (0.041).

Leaf to stem ratio : Leaf to stem ratio exhibited negative direct effect of (-0.094), and it was negatively associated with green forage yield (-0.101). This was due to negative indirect effects of plant spread (-0.070) and number of primary branches (-0.023).

Dry matter yield (g/plant) : Dry matter exhibited negative direct effect of (-0.041), however, it had highly significant and positive association with green forage yield (0.903). This was due to positive indirect effects of plant spread (0.520), plant height (0.87), crude protein yield (0.093), number of primary branches (0.082) and length of leaf sheath (0.076).

Crude protein yield (g/plant) : Crude protein exhibited positive direct effect (0.132), and also it had highly significant positive correlation with green forage yield (0.747). This was due to high indirect effects of plant spread (0.416) followed by plant height (0.138), length of leaf sheath (0.042), number of primary branches (0.034) and leaf breadth (0.015).

In the present study, characters plant spread, plant height, number of primary branches, length of leaf sheath and crude protein yield recorded high to moderate magnitudes of positive direct effects accompanied by highly significant correlation with green forage yield, indicating true and perfect relationship between them. Thus, suggesting that selection of these characters will be highly rewarding for improving the green forage yield.

The yield component via crude protein yield, length of leaf sheath and plant height had also positive indirect effect for majority of traits. The residual effect was 0.177 which indicates that about 82 per cent variability was due to the characters considered for the studies.

Conclusion

Considering correlation coefficient and path analysis simultaneously, plant spread, plant height and number of primary branches per plant were found to be true components of green forage yield in *Stylosanthes* and emphasis should be given on these characters for green forage improvement in the present set of genotypes.

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