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Correlation studies for green manuring traits in Dhaincha (*Sesbania cannabina* L.)

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Abstract
Genotypic correlation and path coefficient analysis were used to determine the effect of various traits as components of biomass yield in thirty dhaincha (*Sesbania cannabina* L.) genotypes. The thirty dhaincha genotypes were evaluated at research farm of department of Genetics and Plant Breeding, Navsari Agriculture University, Navsari during *kharif*-2017. Randomized complete block design with three replicates was used for laying out the field experiments. Highly significant positive genotypic correlations were detected for biomass yield with plant height, number of internodes, number of branches, leaf length, and leaflets per leaf and dry weight of plant. Path analysis revealed that plant height, leaflets per leaf and dry weight of plant had the highest positive direct effect on biomass yield. These results indicate that plant height, leaflets per leaf, stem diameter and dry weight of plant can be used as selection criteria for the improvement of dhaincha biomass yield.

Keywords: correlation studies, green manuring traits, Dhaincha, *Sesbania cannabina*

Introduction

Now-a-days use of agrochemicals and pesticides in non-judicious manner leads to the loss of soil fertility and productivity and has negative impact on human health. Usages of inappropriate technologies have resulted in the deterioration of soil quality leading to soil organic matter losses and structure degradation, affecting water, air and nutrients flows, and consequently plant growth. For this reason, the application of organic matter including green manures to the soil has become a common agricultural practice for soil quality restoration, maintaining soil organic matter, reclaiming degraded soils and for supplying the nutrients to the plant**.** The use of green manuring is the ray of hope in this context (Kumar *et al*., 2014) [8]. Green manuring may play a pivotal role in minimizing the ill effects of intensive agriculture that has resulted in many adverse effects on natural resources.

Dhaincha (*Sesbania cannabina* L.) (2n=2x=24) belongs to family fabaceae sub family papilionaceae is widely grown as a green manure crop in view of its vigorous growth and high potential to increase their biomass in short duration and its ability to fix nitrogen, it is used as green manure for many important food crops. The N fixation in its root nodules and the general ability of the plant to withstand a wide range of soil conditions like salinity, alkalinity, water logging etc. Its cultivation in summer as a catch crop for green manuring of the subsequent wetland rice crop fits soundly into the rice-wheat double-cropping system practised in the irrigated areas of northern India. On decomposition, it increases the humus and available nitrogen contents along with low C: N ratio. Green manuring may also enhance the boron and iron availability in soil (Anonymous, 2004) [1].

In agricultural studies, to maximize the output and to minimize the input, it is very important to know that which factors have an effect on the agricultural yield and whether they directly affect the yield or not? Direct and indirect effects of yield factors are determined with path analysis. The total correlation between predictor variables and response variable are partitioned into direct and indirect effects by path analysis. Path model is a diagram relating to independent and dependent variables. Path coefficient is a standardized regression coefficient showing the direct effect of an independent variable on a dependent variable in the path model. The purpose of this investigation was to present direct and indirect effects of component traits on biomass yield in dhaincha.

Material and Methods

Thirty genotypes were evaluated in trial conducted at research farm of department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari during *kharif*-2017. Three meter row of each genotype was grown at a spacing of 30×15 cm^2 in three replications following randomized block design. Observations were recorded for fourteen quantitative traits *viz.*, days to fifty percent flowering, plant height (cm), root length (cm), stem diameter (cm), number of internodes, branches per plant, leaf length (cm), leaflets per leaf, root nodules per plant, fresh weight of root nodules per plant (g), dry weight of root nodules per plant (g), fresh weight of plant (g), dry weight of plant (g) and C:N ratio. The statistical analysis was done in window stat software to interpret the data.

The correlation coefficient were worked out to determine the degree of association of a character with biomass yield and also among its components. The mean values were used to calculate the phenotypic correlation by using the formula given by Hazel (1943) [6]. The genotypic and phenotypic correlation coefficients were tested against standardized tabulated significant values of r with (g-2) degrees of freedom as per the procedure suggested by Fisher and Yates (1963) [4]. Path analysis was carried out by using both phenotypic and genotypic correlation coefficients to know the direct and indirect effects of the components on yield as suggested by Wright (1921) [16] and illustrated by Dewey and Lu (1959) [3].

Results and Discussion

Biomass yield is a complex trait and is greatly affected by environmental erratic. Moreover, it is intricate in inheritance and may involve several related traits. Hence, correlation coefficient analysis is widely used to measure the degree and direction of relationship between various traits and biomass yield. In the present study, genotypic correlation coefficient between fourteen pairs of traits were calculated (Table 1). Highly positive genotypic correlations ($P \leq 0.01$) were detected for fresh weight of plant with plant height, stem diameter, number of internodes, number of branches, leaf length, leaflets per leaf, root nodules per plant, and dry weight of plant. Whereas, highly negative association was seen with days to fifty percent flowering. Similar observations were drawn by Bakasso and Jongo (2000) [2], Virdi *et al.* (2006a&b) [14, 15], Shegro *et al.* (2013) [12], Kapoor (2014) [7], Nath and Tajane (2014) [10], Sawarkar *et al.* (2014) [11], Gerrano *et al*. (2015) [5] and Meena and Nagar (2017) [9]. Hence, selection of tall plants with early flowering having more branches, long leaves; higher number of leaflets and thicker stem will be effective for improving fresh weight of plant. These traits, besides being correlated with biomass yield, were highly correlated with each other. Thus, if they proved to be controlled by a few number of genes, selection for their combination should not be difficult.

Biomass yield is a complex trait and it is achieved through the interplay of various biomass contributing characters. The characters contribute directly and also indirectly through other characters to the final biomass yield. The analysis of such interplay is done through path coefficient analysis, an account of which is given below (Table 2). The results indicated that fresh weight of plant was positively and directly affected by plant height (0.6514), root length (0.0984), stem diameter (0.3875), leaflets per leaf (0.6297), dry weight of root nodules per plant (0.3536), dry weight of plant (0.8173) and C:N ratio (0.0441). Except days to fifty percent flowering, all other above mentioned traits have positive correlation with biomass yield. The great influence of these traits reflected their importance for biomass yield improvement. These findings are in accordance with Virdi *et al*. (2006a&b) [14, 15], Kapoor (2014) [7] and Nath and Tajane (2014) [10]. Virdi *et al.* (2006a) [14] reported positive direct effect of plant height on biomass yield, however, Nath and Tajane (2014) [10] observed positive direct effect of number of leaves on fresh weight in cow pea. Traits like number of internodes (-0.1665), number of braches (-0.0499), leaf length (-0.5890), root nodules per plant (-0.3033), fresh weight of root nodules per plant (-0.9060) were having negative direct effect on fresh weight of plant but having positive and significant correlation with fresh weight of plant. This suggests indirect selection of these traits through other traits having positive indirect effect on dependent trait. Virdi *et al*. (2006a&b) [14, 15] and Thakur and Sirohi (2009) [13] also reported similar results.

Conclusion

The phenotypic correlation coefficients were higher in magnitude than their corresponding genotypic one, indicating there by strong inherent association between different traits under study. Plant height, root length, stem diameter, number of branches, leaf length, number of leaflets, root nodules per plant and dry weight of plant having significant correlation with fresh weight of plant. Path coefficient analysis of different characters revealed that dry weight of plant had highest positive direct effect followed by plant height and number of leaflets per leaf. Therefore, selection pressure on these characters may be given due importance for genetic improvement. Characters like leaf length, fresh weight of root nodules per plant and root nodules per plant exhibited negative direct effect but positive correlation on biomass yield. An overall observation of path coefficient analysis of fresh weight of plant with its components revealed that the characters plant height, stem diameter, leaflets per leaf, dry weight of root nodules per plant and dry weight of plant played an important role in determining the biomass yield in dhaincha.

Table 1: Genotypic (r_g) and phenotypic (r_p) correlation coefficients of fourteen characters in dhaincha

	C	FWP	DFF	PH	RL	SD	IN	NB	LL	LFT	RN	FWN	DWN	DWP	CNR
DFF	r_g	-0.510**	1.00												
	r_p	-0.467**	1.00												
PH	r_g	0.456**	-0.767**	1.00											
	r_p	0.409**	-0.744**	1.00											
RL	r_g	0.133	-0.522**	0.764**	1.00										
	r_p	0.149	-0.490**	0.695**	1.00										
SD	r_g	0.477**	-0.191	0.506**	0.444**	1.00									
	r_p	0.399**	-0.167	0.436**	0.386**	1.00									
IN	r_g	0.637**	-0.823**	0.699**	0.421**	0.264*	1.00								
	r_p	0.515**	-0.763**	0.679**	0.350**	0.239*	1.00								
NB	r_g	0.565**	-0.257*	-0.079	-0.207	0.238*	0.375**	1.00							
	r_p	0.529**	-0.248*	-0.077	-0.194	0.214*	0.350**	1.00							
LL	r_g	0.565**	-0.527**	0.453**	0.155	0.526**	0.604**	0.498**	1.00						

	r_p	0.503**	-0.494**	0.409**	0.125	0.447**	0.533**	0.460**	1.00					
LFT	r_g	0.564**	-0.462**	0.225*	-0.153	0.235*	0.610**	0.630**	0.724**	1.00				
	r_p	0.496**	-0.443**	0.225*	-0.132	0.179	0.558**	0.595**	0.661**	1.00				
RN	r_g	0.294**	-0.543**	0.474**	0.239*	0.399**	0.619**	0.358**	0.559**	0.585**	1.00			
	r_p	0.261*	-0.493**	0.407**	0.209*	0.329**	0.538**	0.322**	0.503**	0.474**	1.00			
FWN	r_g	0.186	-0.402**	0.708**	0.920**	0.559**	0.254*	-0.320**	0.038	-0.158	0.234*	1.00		
	r_p	0.142	-0.321**	0.549**	0.714**	0.427**	0.230*	-0.250*	0.038	-0.112	0.229*	1.00		
DWN	r_g	0.153	-0.371**	0.674**	0.862**	0.499**	0.231*	-0.309**	0.009	-0.203	0.180	1.00**	1.00		
	r_p	0.120	-0.356**	0.609**	0.755**	0.417**	0.206	-0.306**	0.023	-0.191	0.159	0.841**	1.00		
DWP	r_g	0.842**	-0.526**	0.483**	0.294**	0.470**	0.626**	0.555**	0.624**	0.457**	0.419**	0.270*	0.287**	1.00	
	r_p	0.829**	-0.534**	0.399**	0.297**	0.442**	0.557**	0.545**	0.563**	0.414**	0.376**	0.246*	0.248*	1.00	
CNR	r_g	0.069	0.146	-0.462**	-0.526**	-0.224*	0.152	0.406**	0.117	0.181	0.088	-0.688	-0.606**	0.046	1.00
	$\mathbf{r_p}$	0.044	0.145	-0.440**	-0.486**	-0.179	0.157	0.394**	0.102	0.170	0.070	-0.533	-0.565**	0.074	1.00

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

DFF= Days to 50% flowering IN= Internodes per plant RN= Root nodules per plant FWP=Fresh weight of plant (g)
PH= Plant height (cm) NB= Branches per plant FWN=Fresh weight of root nodules per plant (g) DWP= Dry weight of plant (g)
RL= Root length (cm) LL= Leaf length (cm) DWN= Dry weight of root nodules per plant (g) CNR= C: N ratio
SD= Stem diameter (cm) LFT=Leaflets per leaf

Table 2: Path coefficient analysis showing direct and indirect effects of thirteen characters on biomass yield per plant of dhaincha

Characters	DFF	PH	RL	SD	IN	NB	LL	LFT	RN	FWN	DWN	DWP	CNR
DFF	0.0095	-0.0073	-0.0049	-0.0018	-0.0078	-0.0024	-0.0050	-0.0044	-0.0051	-0.0058	-0.0035	-0.0056	0.0014
PH	-0.4999	0.6514	0.4976	0.3294	0.4553	-0.0516	0.2953	0.1463	0.3084	0.4613	0.4388	0.2973	-0.3010
RL	-0.0514	0.0752	0.0984	0.0430	0.0415	-0.0204	0.0152	-0.0150	0.0235	0.0906	0.0848	0.0290	-0.0513
SD	-0.0740	0.1959	0.1721	0.3875	0.1022	0.0923	0.2041	0.0912	0.1545	0.2165	0.1933	0.1849	-0.0869
IN	0.1371	-0.1164	-0.0701	-0.0439	-0.1665	-0.0625	-0.1005	-0.1015	-0.1031	-0.0442	-0.0384	-0.1061	-0.0253
NB	0.0128	0.0040	0.0103	-0.0119	-0.0187	-0.0499	-0.0248	-0.0314	-0.0179	0.0160	0.0163	-0.0282	-0.0203
LL	0.3103	-0.2670	-0.0910	-0.3103	-0.3557	-0.2933	-0.5890	-0.4264	-0.3291	-0.0224	-0.0055	-0.3674	-0.0687
LFT	-0.2911	0.1414	-0.0960	0.1482	0.3838	0.3967	0.4558	0.6297	0.3684	-0.0992	-0.1281	0.2878	0.1142
RN	0.1646	-0.1436	-0.0725	-0.1210	-0.1878	-0.1085	-0.1695	-0.1774	-0.3033	-0.0711	-0.0547	-0.1269	-0.0268
FWN	0.3639	-0.6415	-0.8336	-0.5064	-0.2298	0.2901	-0.0345	0.1427	-0.2124	-0.9060	-0.9113	-0.2447	0.6236
DWN	-0.1312	0.2382	0.3047	0.1764	0.0816	-0.1155	0.0033	-0.0719	0.0638	0.3557	0.3536	0.1014	-0.2141
DWP	-0.4829	0.3729	0.2406	0.3901	0.5209	0.4619	0.5098	0.3736	0.3421	0.2207	0.2343	0.8173	0.0566
CNR	0.0064	-0.0204	-0.0230	-0.0099	0.0067	0.0179	0.0051	0.0080	0.0039	-0.0303	-0.0267	0.0031	0.0441
Correlation with FWP	-0.5259**	0.4829**	0.1325	0.4702**	0.6256**	0.5548**	0.5652**	0.5635**	0.2938**	0.1856	0.1530	0.8418**	0.0455

*, **Significant at 5% and 1% level, respectively. Residual effect =0.344. Bold figures show direct effect+

DF= Days to 50% flowering IN= Internodes per plant RN= Root nodules per plant DWN= Dry weight of root nodules (g)
PH= Plant height (cm) NB= Branches per plant FWN=Fresh weight of root nodules per plant (g) FWP=Fresh weight of plant (g)
RL= Root length (cm) LL= Leaf length (cm) DWN= Dry weight of root nodules per plant (g) DWP= Dry weight of plant (g)
SD= Stem diameter (cm) LFT= Leaflets per leaf CNR= C: N ratio

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