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Path Matrix Analysis of Cane Yield and Their Component Traits in Spring Planting of Sugarcane under Waterlogging Condition

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ABSTRACT

A study was conducted with sixteen genotypes received from Sugarcane Research Institute, D.R.P.C.A.U., Pusa, Samastipur, Bihar. The experiment was conducted in Randomized Block Design with three replications during spring season 2016 in paddy block, to evaluate the midlate sugarcane clones for waterlogging tolerance. Observations on a total of twenty-five quantitative and qualitative characters were recorded. The result of present study clearly indicated that highest positive direct effect on cane yield was exerted by pol percent at 12 months stage, sugar yield, brix percentage at 10 months stage, single cane weight and purity percentage at 10 months stage at phenotypic level, hence these traits can be used for clonal selection programme on sugarcane for sub-tropical regions.

Key words: *Sugarcane, Phenotypic level, Genotypes, Yield*

INTRODUCTION

Sugarcane crop occupies in several parts of India (Assam, Bihar, and West Bengal, eastern Uttar Pradesh, Coastal region of Andhra Pradesh, Tamil Nadu, Kerala and Karnataka) are exposed to stagnant water for two to three months during monsoon season. The short fall in yield potential is mainly due to various biotic and abiotic stresses in Bihar in which waterlogging is the main factor because in Bihar about 35-40 per cent of sugarcane remains waterlogged during monsoon season which coincides with the grand growth period of the crop.

Yield in sugarcane is dependent on a number of factors. Agronomist and breeders have adopted yield component studies through correlation and path coefficient analysis, as a crop improvement strategy. The concept of correlation is used to explore and reveal the relationship between yield and its components. It has also proved valuable in determining the association of quantitative attributes with yield for selecting characters that influence the yield, but the correlation values decide only the nature and degree of association existing between pairs of characters. The economic character like yield is dependent on several mutually associated component characters and hence change in any one of the component is likely to affect the whole network of cause and effect.

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This in turn might affect the true association of component characters both in magnitude and direction and tend to vitiate the association of yield with its attributes. Hence, it has to be analyzed through path analysis, where the two types of action namely direct effect of component characters on the yield and the indirect effects through other component characters on the yield are obtained which cannot be ascertained through correlation studies. Path co-efficient is the standardized partial regression coefficient of correlation, which splits correlation co-efficient into direct and indirect effects of component characters on complex dependent character like yield.

The present investigation was taken up to study direct and indirect inter-relationships among cane yield and their component traits of the spring-planted sugarcane in waterlogged environments.

MATERIAL AND METHODS

Climate

The experimental plot was well leveled but remain waterlogged during May to September 2016 due to low land. The average depth of water varied from 30 to 90 cm and 130 cm for 15 days during September, 2016. The month wise temperature, relative humidity and rainfall data has been provided at Fig: 1

Treatments and experimental design

The sixteen sugarcane clones viz. CoP 09437, CoP 11439, CoP 11440, CoP 12438, CoP 12439, CoP 13438, CoP 13439, CoP 14438, CoP 14439, CoP 15439, CoP 15440, CoP 15441, BO 155 and CoP 2061 were evaluated along with two standard check BO91 and BO154. The trial was laid out in randomized block design with three replications. Equal number of three budded set of each clones was planted.

Data collected and analysis

Data were collected for yield attributing traits viz. germination percentage at 45 DAP (Days After Planting), number of shoots at 120 DAP. (000/ha), plant height at 150, 240, 360 days (cm), number of fully emerged leaves at 30 days and 60 days after waterlogging, leaf area index before waterlogging, at 30 and 60 days after waterlogging, number of nodes with aerial roots, cane diameter at harvest (cm), number of shoots at 240 DAP (000/ha), number of millable canes at harvest (000/ha), single cane weight (Kg), cane yield (t/ ha) and sugar yield (CCS t/ha) at harvest and juice quality traits viz. brix, Pol and Purity at 10 &12 months stage (%), CCS % at 10 and 12 months stage. Chemical analyses of sugarcane juice for brix (%), pol (%), purity (%) and CCS (%) were done.

Path coefficient analysis

Path coefficient was obtained according to the procedure suggested by Deway and Lu [1]and the direct and indirect effects are rated as follows by Lenka and Mishra.

RESULTS AND DISCUSSION

In the present investigation, twenty-five associated characters were subjected separately to path analysis for partitioning the correlation values into direct and indirect effects through alternative path ways and results are discussed below.

Present investigation, genotypic and phenotypic path matrix (Tables 1 and 2) indicated that, highest positive direct effect on cane yield was exerted by pol percent at 12 months stage, sugar yield, brix percentage at 10 months stage, single cane weight and purity percentage at 10 months stage at phenotypic level. In the other words these characters were directly responsible for higher cane yield. Although, at phenotypic level, CCS percentage at 12 months stage, brix percentage at 12 months stage, pol percentage at 10 months stage and number of fully emerged leaves at 60 days after waterlogging showed negative direct effect on cane yield and their indirect effect via each other was also negative. At genotypic level, brix percentage at 12 months stage recorded highest direct positive effect on cane yield followed by CCS percentage at 12 months stage, CCS percentage at 10 months stage, sugar yield, leaf area index at 30 days after waterlogging, purity percentage at 12 months stage and single cane weight. Other characters like pol percentage at 12 months stage, pol percentage at 10 months stage, brix percentage at 10 months stage, plant height at 360 DAP, purity percentage at 10 months

stage and leaf area index before waterlogging at genotypic level recorded negative direct effect. Tena *et al.*[4] observed that highest positive direct effect of number of millable cane number on cane yield followed by single cane weight and pol percentage. Masri[3] found that genotypic path coefficient of stalk diameter, stalk number had positive direct effect on cane yield. These finding are in agreement with chaudhary and Joshi[2], Smiullah *et al.*[6], Seeja and Sreekumar[8], Das *et al.* and Sanghera *et al.*[5]. Singh *et al.*[7] also found that number of millable canes, single cane weight and stalk diameter reflected highly positive direct effect on ratoon yield at genotypic level, whereas stalk length showed negative direct but highly positive indirect effect via pol percent in juice and single cane weight. Patel *et al.*[9] found that high positive direct of CCS on cane yield and suggested that for improving cane yield in sugarcane more emphasis should be given to single cane weight, number of millable cane per ha and commercial cane sugar (t/ha). Kumar and Singh[10] observed that single cane weight, cane diameter and number of shoots were important characters contributing towards cane yield, these characters should be given due consideration for selection of high yielding sugarcane varieties.

The characters sugar yield, single cane weight, number of millable cane at harvest, cane diameter at harvest and leaf area index at 30 days after waterlogging showed positive direct effect on cane yield both at genotypic and phenotypic levels, therefore these traits may be considered as important characters contributing towards cane yield under waterlogging. On account of genetic coefficient of variation, heritability estimates, genetic advance, as percent of mean as well as positive direct effect or indirect effect through other characters, sugar yield, single cane weight, number of millable cane at harvest, cane diameter at harvest and leaf area index at 30 days after waterlogging can also be considered as the component characters of cane yield.

Residual effect

The lower value of residual effect in case of both genotypic as well as phenotypic path coefficient indicates that the all important characters were studied.

Table 1: Genotypic path coefficient of twenty-five traits of sugarcane clones under waterlogging condition

Traits	X1	X2	X3	X4	X5	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25
X1	**-0.063**	-0.060	-0.052	-0.052	-0.036	0.014	-0.005	-0.003	0.009	0.009	0.010	0.012	0.002	-0.043	-0.040	-0.003	-0.003	-0.027	-0.019	-0.027	-0.021	-0.029	0.007	-0.008
X2	0.153	**0.160**	0.150	0.157	0.122	0.021	0.037	-0.034	0.004	0.004	-0.004	-0.004	0.016	0.122	0.102	0.048	0.032	0.079	0.074	0.078	0.048	0.071	0.006	-0.002
X3	-0.017	-0.019	**-0.020**	-0.018	-0.013	0.005	0.004	0.001	-0.002	-0.004	0.001	0.002	-0.011	-0.015	-0.015	-0.002	0.001	0.008	-0.010	-0.012	-0.011	-0.013	-0.002	-0.003
X4	0.128	0.152	0.138	**0.156**	0.139	-0.016	0.053	-0.047	0.000	-0.027	-0.011	-0.025	0.015	0.122	0.110	0.072	0.040	0.110	0.118	0.122	0.067	0.112	0.006	-0.030
X5	0.267	0.350	0.295	0.410	**0.460**	-0.029	0.194	-0.137	0.091	-0.065	0.063	0.171	-0.006	0.243	0.187	0.364	0.357	0.365	0.372	0.304	0.248	0.394	0.102	-0.076
X7	0.291	0.174	0.348	-0.135	-0.083	**1.338**	-0.082	1.195	0.971	1.335	1.084	0.142	0.095	-0.252	0.021	-0.405	-0.217	-0.619	-0.498	-0.565	-0.402	0.680	0.911	1.330
X8	-0.016	-0.050	-0.044	-0.073	-0.090	0.013	**-0.215**	-0.034	-0.115	-0.009	-0.091	-0.015	-0.003	-0.096	-0.113	-0.097	-0.052	-0.018	-0.053	-0.043	-0.006	-0.035	-0.130	-0.006
X9	0.014	-0.058	0.015	-0.082	-0.081	0.245	0.043	**0.274**	0.111	0.255	0.117	-0.036	-0.135	-0.069	-0.071	-0.116	-0.102	-0.165	-0.156	-0.078	-0.014	-0.055	0.105	0.259
X10	0.038	-0.006	-0.020	-0.001	-0.051	-0.185	-0.137	-0.104	**-0.255**	-0.170	-0.256	-0.127	-0.074	-0.089	-0.106	-0.033	-0.004	-0.019	-0.004	-0.036	-0.138	-0.180	-0.255	-0.166
X11	-0.392	-0.063	-0.476	-0.456	-0.374	2.643	-0.108	2.467	1.766	**-2.650**	1.979	-0.236	-0.474	-0.611	-0.184	-0.930	-0.567	-1.384	-1.208	-1.120	-0.533	-0.859	-1.645	-2.649
X12	0.040	0.006	-0.011	0.017	-0.033	-0.194	-0.102	-0.103	-0.240	-0.179	**-0.240**	-0.127	-0.079	-0.057	-0.074	-0.013	-0.009	-0.024	-0.017	-0.048	-0.135	-0.167	-0.238	-0.175
X13	0.010	0.001	0.006	0.008	-0.019	-0.005	-0.004	-0.007	-0.025	-0.005	-0.027	**-0.051**	-0.030	-0.003	-0.008	-0.040	-0.035	-0.031	-0.026	-0.011	-0.054	-0.054	-0.023	-0.004
X14	-0.003	-0.007	-0.035	-0.006	-0.001	-0.005	-0.001	-0.032	-0.019	-0.012	-0.022	-0.038	**-0.065**	-0.002	-0.001	-0.003	-0.004	-0.003	-0.016	-0.012	-0.035	-0.028	-0.016	-0.014
X15	0.145	0.160	0.160	0.165	0.111	-0.040	-0.094	-0.053	-0.073	-0.049	-0.050	-0.014	-0.008	**0.211**	0.216	0.025	0.040	0.149	0.151	0.160	0.100	0.142	-0.086	-0.052
X16	-0.145	-0.145	-0.172	-0.160	-0.092	-0.004	-0.119	-0.059	-0.094	-0.016	-0.069	-0.036	-0.002	-0.232	**-0.226**	-0.021	-0.005	-0.136	-0.125	-0.148	-0.078	-0.122	-0.107	-0.022
X17	0.015	0.082	0.032	0.126	0.215	-0.083	-0.124	-0.116	-0.035	-0.096	-0.015	-0.213	-0.012	-0.033	-0.026	**0.272**	0.314	0.217	0.193	0.107	0.093	0.133	0.041	-0.100
X18	0.000	0.000	0.000	0.000	0.001	-0.001	0.000	-0.001	0.000	-0.000	0.000	-0.001	0.000	0.000	0.000	-0.001	**0.001**	-0.001	-0.001	0.000	0.000	0.000	0.000	-0.000
X19	-0.048	-0.055	-0.042	-0.078	-0.088	-0.051	-0.009	-0.067	-0.008	-0.058	-0.011	-0.068	-0.004	-0.078	-0.067	-0.089	-0.094	**-0.111**	-0.111	-0.091	-0.053	-0.083	-0.009	-0.060
X20	0.085	0.130	0.136	0.213	0.228	-0.105	-0.070	-0.160	-0.005	-0.128	-0.020	-0.146	-0.069	-0.201	-0.156	-0.199	-0.186	-0.282	**-0.281**	-0.270	-0.158	-0.216	-0.000	-0.136
X21	-0.032	-0.036	-0.045	-0.058	-0.048	-0.031	-0.015	-0.021	-0.010	-0.031	-0.015	-0.016	-0.013	-0.056	-0.048	-0.029	-0.011	-0.060	-0.070	**-0.073**	-0.035	-0.037	-0.009	-0.031
X22	0.006	0.005	0.009	0.008	0.010	0.005	0.001	-0.001	0.010	0.004	0.010	0.019	0.010	0.008	0.006	0.006	0.005	0.009	0.010	0.009	**0.018**	0.022	0.009	0.003

X23	-0.013	-0.013	-0.018	-0.020	-0.024	-0.014	-0.005	0.006	-0.020	-0.009	-0.020	-0.030	-0.012	-0.019	-0.015	-0.014	-0.006	-0.021	-0.022	-0.014	-0.034	**-0.028**	-0.019	-0.007
X24	-0.068	-0.023	-0.065	-0.023	-0.136	-0.417	-0.369	-0.234	-0.611	-0.380	-0.607	-0.270	-0.150	-0.251	-0.289	-0.093	-0.006	-0.047	-0.001	-0.075	-0.308	-0.410	**-0.612**	-0.371
X25	-0.119	-0.011	-0.145	-0.185	-0.158	-0.945	-0.025	-0.897	-0.619	-0.950	-0.692	-0.075	-0.203	-0.233	-0.094	-0.348	-0.223	-0.515	-0.458	-0.399	-0.161	-0.250	-0.576	**-0.951**
X6	**0.521**	**0.723**	**0.564**	**0.870**	**0.979**	**-0.264**	**0.427**	**-0.466**	**0.054**	**-0.338**	**-0.025**	**0.330**	**0.027**	**0.545**	**0.39**	**0.840**	**0.802**	**0.876**	**0.865**	**0.707**	**0.456**	**0.740**	**0.087**	**-0.360**

RESIDUAL EFFECT = 0.016

X1- Germination Percentage at 45 DAP
X2- Number of Shoots at 120 DAP
X3- Number of Shoots at 240 DAP
X4- Number of Millable Canes at Harvest (000/ha)
X5- Sugar Yield (t/ha)
X6- Cane yield (t/ha)
X7- Brix % at 12 Months Stage
X8- Purity % at 10 Months Stage
X9- Purity % at 12 Months Stage
X10- Pol % at 10 Months Stage
X11 - Pol % at 12 Months Stage
X12- Brix % at 10 Months Stage
X13- Number of Nodes with Aerial Roots
X14- Plant Height at 150 DAP (cm)
X15- Plant Height at 240 DAP (cm)
X16- Plant Height at 360 DAP (cm)
X17- Single Cane Weight (kg)
X18- Cane Diameter at Harvest (cm)
X19- Leaf Area Index Before Waterlogging
X20- Leaf Area Index at 30 Days After Waterlogging
X21 - Leaf Area Index at 60 Days After Waterlogging
X22- Number of Fully Emerged Leaves at 30 Days After Waterlogging
X23- Number of Fully Emerged Leaves at 60 Days After Waterlogging
X24- CCS % at 10 Months Stage
X25- CCS % at 12 Months Stage

Table 2: Phenotypic path coefficient of twenty-five traits of sugarcane clones under waterlogging condition

Traits	X1	X2	X3	X4	X5	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25
X1	**0.006**	0.004	0.004	0.004	0.002	0.000	0.000	-0.001	-0.001	-0.001	-0.001	0.000	-0.001	0.001	0.002	0.000	0.001	0.001	0.002	0.002	0.001	0.002	-0.001	-0.001
X2	0.003	**0.005**	0.003	0.003	0.003	0.000	0.001	0.001	-0.001	0.000	-0.001	-0.001	-0.001	0.001	0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.002	-0.001	0.001
X3	0.007	0.007	**0.012**	0.007	0.006	0.002	0.001	-0.000	0.001	0.001	0.001	-0.001	0.003	0.003	0.003	0.002	-0.001	0.003	0.004	0.004	0.004	0.005	0.001	0.001
X4	0.047	0.041	0.047	**0.078**	0.061	-0.001	0.010	-0.020	0.006	-0.009	0.005	0.005	0.001	0.034	0.035	0.017	0.015	0.035	0.040	0.038	0.021	0.027	0.007	-0.011
X5	0.333	0.460	0.427	0.650	**0.832**	0.145	0.257	-0.056	0.228	0.098	0.188	0.109	0.093	0.328	0.264	0.582	0.323	0.460	0.410	0.308	0.295	0.359	0.243	0.079
X7	-0.004	-0.007	-0.047	0.005	-0.048	**-0.273**	-0.047	-0.107	-0.144	-0.261	-0.151	-0.003	-0.058	-0.043	-0.034	0.040	0.052	0.037	0.087	0.086	-0.063	-0.028	-0.137	-0.252
X8	0.001	0.004	0.002	0.006	0.014	0.008	**0.044**	0.009	0.027	0.009	0.018	-0.005	0.005	0.001	-0.006	0.012	0.003	0.002	0.005	0.001	-0.005	-0.005	0.030	0.010
X9	-0.002	0.005	-0.001	-0.013	-0.003	0.020	0.010	**0.051**	0.007	0.032	0.004	-0.009	0.002	-0.004	-0.003	-0.007	-0.007	-0.015	-0.020	-0.014	-0.002	-0.001	0.009	0.036
X10	0.007	0.009	-0.015	-0.014	-0.052	-0.100	-0.118	-0.027	**-0.188**	-0.094	-0.181	-0.026	-0.043	-0.003	0.015	-0.026	0.008	0.015	0.005	0.026	-0.041	-0.022	-0.187	-0.091
X11	-0.019	0.042	0.139	-0.129	0.138	1.117	0.243	0.734	0.584	**1.167**	0.589	-0.063	0.218	0.124	0.098	-0.184	-0.236	-0.235	-0.454	-0.415	0.212	0.081	0.569	1.161
X12	-0.009	-0.012	0.014	0.010	0.038	0.093	0.069	0.014	0.161	0.085	**0.168**	0.034	0.036	-0.004	-0.013	0.012	-0.012	-0.016	-0.009	-0.026	0.050	0.032	0.156	0.080
X13	0.000	-0.001	-0.001	0.000	0.001	0.000	-0.001	-0.001	0.001	-0.001	0.001	**0.005**	0.001	-0.001	-0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	-0.001
X14	0.001	0.000	-0.002	-0.001	-0.001	-0.002	-0.001	-0.001	-0.002	-0.002	-0.002	-0.002	**-0.010**	-0.003	-0.002	-0.001	0.000	-0.001	-0.001	0.000	-0.003	-0.001	-0.002	-0.002
X15	0.001	0.001	0.002	0.002	0.002	0.001	0.000	-0.001	0.000	0.001	-0.001	-0.001	0.002	**0.005**	0.005	0.001	0.001	0.002	0.002	0.002	0.001	0.002	0.000	0.000
X16	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.001	**-0.001**	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	-0.001
X17	0.005	0.032	0.013	0.022	0.069	-0.014	0.027	-0.013	0.014	-0.016	0.007	0.018	0.009	0.010	-0.004	**0.098**	0.054	0.045	0.041	0.024	0.017	0.029	0.015	-0.016
X18	0.001	0.002	-0.001	0.002	0.004	-0.002	0.001	-0.002	-0.001	-0.002	-0.001	0.004	-0.001	0.002	0.002	0.006	**0.011**	0.005	0.003	0.002	0.000	0.004	-0.001	-0.002
X19	0.008	0.012	0.009	0.016	0.019	-0.005	0.001	-0.010	-0.003	-0.007	-0.003	0.007	0.003	0.015	0.012	0.016	0.014	**0.035**	0.027	0.019	0.013	0.016	-0.003	-0.008
X20	0.001	0.001	0.001	0.003	0.002	-0.002	0.001	-0.002	-0.001	-0.002	-0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.004	**0.005**	0.004	0.002	0.002	-0.001	-0.002
X21	-0.003	-0.002	-0.003	-0.004	-0.003	0.003	-0.001	0.002	0.001	0.003	0.001	-0.001	0.000	-0.002	-0.002	-0.002	-0.002	-0.005	-0.007	**-0.008**	-0.003	-0.003	0.001	0.003
X22	0.000	0.000	0.001	0.001	0.001	0.001	-0.001	-0.001	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.001	**0.002**	0.001	0.000	0.000
X23	-0.010	-0.015	-0.016	-0.014	-0.017	-0.004	0.004	0.001	-0.005	-0.003	-0.007	-0.010	-0.004	-0.012	-0.009	-0.011	-0.014	-0.017	-0.014	-0.015	-0.024	**-0.038**	-0.004	-0.002
X24	-0.001	-0.001	0.001	0.002	0.005	0.008	0.011	0.003	0.016	0.008	0.015	0.002	0.004	0.000	-0.001	0.003	-0.001	-0.002	-0.001	-0.002	0.003	0.002	**0.016**	0.008
X25	0.029	-0.045	-0.117	0.165	-0.112	-1.081	-0.255	-0.821	-0.565	-1.165	-0.561	0.087	-0.204	-0.096	-0.076	0.188	0.239	0.261	0.477	0.423	-0.188	-0.066	-0.555	**-1.172**
X6	**0.403**	**0.543**	**0.473**	**0.800**	**0.961**	**-0.087**	**0.258**	**-0.247**	**0.139**	**-0.157**	**0.090**	**0.153**	**0.057**	**0.358**	**0.286**	**0.751**	**0.454**	**0.6174**	**0.603**	**0.463**	**0.296**	**0.400**	**0.160**	**-0.179**

RESIDUAL EFFECT=0.027

X1- Germination Percentage at 45 DAP
X2- Number of Shoots at 120 DAP
X3- Number of Shoots at 240 DAP
X4- Number of Millable Canes at Harvest (000/ha)
X5- Sugar Yield (t/ha)
X6- Cane yield (t/ha)
X7- Brix % at 12 Months Stage
X8- Purity % at 10 Months Stage
X9- Purity % at 12 Months Stage
X10- Pol % at 10 Months Stage
X11 - Pol % at 12 Months Stage
X12- Brix % at 10 Months Stage
X13- Number of Nodes with Aerial Roots
X14- Plant Height at 150 DAP (cm)
X15- Plant Height at 240 DAP (cm)
X16- Plant Height at 360 DAP (cm)
X17- Single Cane Weight (kg)
X18- Cane Diameter at Harvest (cm)
X19- Leaf Area Index Before Waterlogging
X20- Leaf Area Index at 30 Days After Waterlogging
X21 - Leaf Area Index at 60 Days After Waterlogging
X22- Number of Fully Emerged Leaves at 30 Days After Waterlogging
X23- Number of Fully Emerged Leaves at 60 Days After Waterlogging
X24- CCS % at 10 Months Stage
X25- CCS % at 12 Months Stage

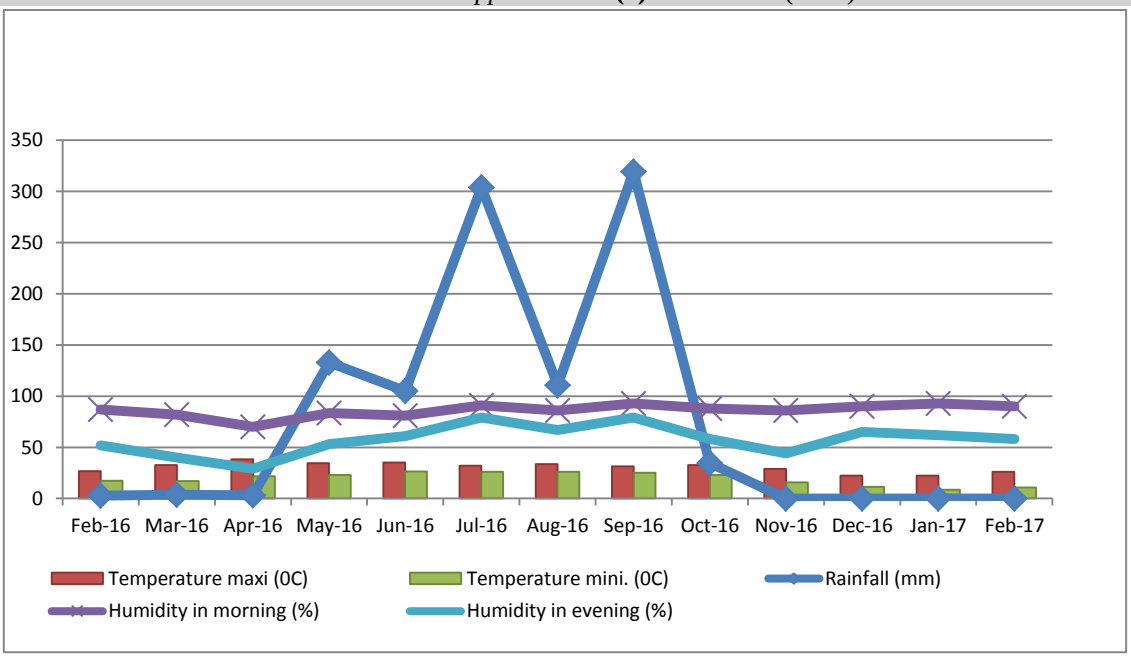

Fig. 1: Meteorological data recorded monthly during cropping season 2016-17

Source : Dept. of Agro meteorology, DR.R.P.C.A.U., Pusa, Samastipur, Bihar

CONCLUSIONS

Path coefficient analysis of cane yield with its component characters revealed highest positive direct effect on cane yield was exerted by pol percent at 12 months stage, sugar yield, brix percentage at 10 months stage, single cane weight and purity percentage at 10 months stage at phenotypic level whereas, CCS percentage at 12 months stage, brix percentage at 12 months stage, pol percentage at 10 months stage and number of fully emerged leaves at 60 days after waterlogging showed negative direct effect on cane yield. At genotypic level, brix percentage at 12 months stage recorded highest direct positive effect on cane yield followed by CCS percentage at 12 months stage, CCS percentage at 10 months stage, sugar yield, leaf area index at 30 days after waterlogging, purity percentage at 12 months stage and single cane weight. The characters sugar yield, single cane weight, number of millable cane at harvest, cane diameter at harvest and leaf area index at 30 days after waterlogging showed positive direct effect on cane yield both at genotypic and phenotypic levels.

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