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Studies on correlation and path analysis in Naga King Chilli (*Capsicum chinense* Jacq.)

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Abstract
Eight landraces of Naga King Chilli (*Capsicum chinense* Jacq.) were evaluated under experimental open field condition of Genetics and Plant Breeding Department NU: SASRD for various genetic parameters, under Randomized Block Design. Fruit yield per plant was found to be positively and significantly correlated with days to first flowering, fruit length, fruit width, fresh fruit weight and dry fruit weight. Study revealed that fresh fruit weight contributed maximum positive direct effect on fruit yield per plant followed by plant height and 1000 seed weight. Fresh fruit weight exerted positive direct effect and also exhibited significant positive correlation with yield indicating a true relationship between the traits.

Keywords: Correlation, Naga king Chilli, path coefficient, landrace

Introduction
Chilli belongs to the family Solanaceae and have five cultivated species *viz Capsicum annuum*, *Capsicum chinense*, *Capsicum frutescens*, *Capsicum baccatum* and *Capsicum pubescens*. Naga King Chilli (*Capsicum chinense* Jacq.) is native to the Northeastern states of India and is considered as India's hottest Chilli measuring at 8,55,000 Schoville Heat Unit (Mathur *et al.*, 2000) [8]. Most of the Chilli species and varieties cultivated in India contain around 1% capsaicin but Naga King Chilli has around 2-4% capsaicin as reported by various researchers (Mathur *et al*., 2000 and Sanatombi and Sharma, 2008) [8, 13]. King Chilli has been reported to show anticancer effect (Moore and Moore, 2003 and Baek *et al.*, 2008) [10, 2] and it also provides relief in arthritis and respiratory ailments (Mazzone and Geraghty, 1999) [9]. Capsaicin has also been reported to show protective effects against cholesterol and obesity (Kempaiah *et al.*, 2005) [7]. Yield being a complex character influenced by several genetic factors it is imperative to study association of different quantitative characters among different relevant traits and path coefficient provides a good index for selection by separating the correlation coefficient of yield and its components into direct and indirect effects (Jha *et al.*, 1996) [6]. Considering the importance of correlation and path coefficient, the research was done for advancement of better and an efficient breeding program.

Materials and Methods
The present investigation was conducted for two growing Seasons i.e 2014 and 2015 under open field condition located in the Experimental Farm of Genetics and Plant Breeding NU: SASRD. The experiment was conducted in Randomized Block Design (RBD) with three replications accommodating 12 plants in each plot of (3x2.25) m^2 with a spacing of 75 cm between the plants and rows.
The experimental materials in the present study comprise of eight landraces of Naga King Chilli procured from five districts of different growing locations in Nagaland. The particulars of the landraces are presented in Table 1. The observations were recorded for the characters such as days to first flowering, plant height, days to 50% fruiting, number of fruits per plant, fruit yield per plant, fresh fruit weight (g), dry fruit weight (g), number of seeds per fruit, 1000-seed weight (g), fruit length (cm), fruit width (cm) and number of fruits per cluster. The correlations were worked out as per methods suggested by Al-Jibouri *et al*. (1958) [1] and path analysis was calculated according to Dewey and Lu (1959) [3].

Results and Discussion
Correlation coefficient is a statistical measure, which denotes the degree and magnitude of association between any two casually related variables. This correlation is due to pleitropic gene action or linkage or more likely both. In plant breeding, correlation coefficient determines character association for improvement yield and other economic characters.

Since the association pattern among yield components help to select the superior genotypes from divergent population based on more than one interrelated characters. Thus information on the degree and magnitude of association between characters is of prime important for the breeder to initiate any selection plan. In general the genotypic correlation was higher in magnitude than phenotypic correlation indicating that inherent association between various characters studied.

In the correlation studies (Table 2) it was found that fruit yield per plant had a significant positive genotypic and phenotypic correlation with number of fruits per plant, thus indicating that selection for these traits will lead to the simultaneous improvement of fruit yield per plant. This is in conformity with Diwaker Kumar *et al.* (2012) [4] and Santosh Kumari (2013) [14]. At genotypic level, plant height exhibited significant positive correlation with number of fruits per plant and fresh fruit weight. A positive significant correlation was also exhibited by number of fruits per plant with number of fruits per cluster and dry fruit weight. Fresh fruit weight exhibited significant positive genotypic correlation with fruit length and fruit yield per plant. Fruit length exhibited significant positive genotypic correlation with number of fruits per cluster and fruit yield per plant. Number of fruits per cluster exhibited positive correlation with dry fruit weight and fruit yield per plant at genotypic level. Similar results were found out by Gupta *et al.* (2009) [5]; Sharma *et al.* (2009) [16]; Padhar and Zaveri (2010) [11]; Singh and Singh (2012) [17].

The path analysis (Table 3) revealed that fresh fruit weight (22.624) contributed maximum positive direct effect on fruit yield per plant followed by plant height (17.944) and 1000 seed weight (11.038) at genotypic level. Fresh fruit weight exerted positive direct effect and also exhibited significant positive correlation with yield indicating a true relationship between the traits. This finding is in confirmity with Sarkar *et al.* (2009) [15] and Rani (1996) [12]. This suggested that the direct relation for fresh fruit weight would likely be effective in increasing the fruit yield per plant. The residual effect estimated was 0.032 indicating that the traits under study are 96.8% sufficient to account for variability but there might be a few more pertinent characters other than those studied in the present investigation and thus solicits inclusion of some more characters. The present study suggested that while selection, emphasis should be given for fresh fruit weight for improvement of the fruit yield per plant.

Table 1: Particulars of the landraces

Code	Place of collection	District
C1	Mangkolemba	Mokokchung
C2	Mon	Mon
C3	Tsiephama	Dimapur
C4	Rhazaphema	Dimapur
C5	Medziphema	Dimapur
C6	Jaluki 1	Peren
C7	Jaluki 2	Peren
C8	Thekrezhüma	Kohima

Table 2: Phenotypic (r_p) and genotypic correlation (r_g) among quantitative characters in Naga King Chilli

Characters	Plant height (cm)	Days to 50% fruiting	Number of fruit per plant	Fresh fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Number of fruits per cluster	Number of seed per fruit	Dry fruit weight (g)	1000 seed weight (g)	Fruit yield per plant (g)
Days to first flowering	-0.100	0.212	-0.340	-0.186	-0.159	-0.179	-0.265	-0.175	0.041	0.066	-0.806**
	(-0.212)	(0.044)	(-0.428)	(-0.299)	(-0.221)	(-0.165)	(-0.460)	(-0.198)	(0.222)	(0.060)	(-0.984**)
Plant height (cm)	-	0.186	0.349	0.205	0.369	0.183	0.232	-0.305	0.054	0.047	0.266
	-	(0.268)	(0.665*)	(0.782*)	(0.529)	(0.312)	(0.368)	(-0.549)	(0.130)	(0.036)	(0.509)
Days to 50% fruiting	-	-	-0.223	-0.124	-0.369	0.180	-0.149	-0.099	0.042	0.136	-0.151
	-	-	(-0.499)	(-0.217)	(-0.845**)	(0.226)	(-0.339)	(-0.182)	(0.665*)	(0.458)	(-0.263)
Number of fruit per plant	-	-	-	0.300	0.429	0.224	0.493	-0.198	-0.072	-0.359	0.623*
	-	-	-	(0.545)	(0.212)	(0.406)	(0.827**)	(-0.161)	(0.839**)	(-0.367)	(0.874**)
Fresh fruit weight (g)	-	-	-	-	0.529	0.422	0.287	-0.0070	0.448	-0.145	0.351
	-	-	-	-	(0.790*)	(0.205)	(0.530)	(-0.739*)	(-0.090)	(-0.461)	(0.973**)
Fruit length (cm)	-	-	-	-	-	0.0035	0.434	-0.126	0.304	-0.174	0.378
	-	-	-	-	-	(0.145)	(0.815**)	(-0.682*)	(-0.351)	(-0.266)	(0.727*)
Fruit width (cm)	-	-	-	-	-	-	0.183	0.030	0.190	-0.050	0.231
	-	-	-	-	-	-	(0.394)	(-0.025)	(0.436)	(-0.060)	(0.400)
Number of fruits per cluster	-	-	-	-	-	-	-	-0.121	0.092	-0.132	0.469
	-	-	-	-	-	-	-	(-0.088)	(0.759*)	(-0.031)	(0.772*)
Number of seeds per fruit	-	-	-	-	-	-	-	-	0.016	0.141	-0.110
	-	-	-	-	-	-	-	-	(-0.830**)	(0.240)	(0.120)
Dry fruit weight (g)	-	-	-	-	-	-	-	-	-	0.019	0.077
	-	-	-	-	-	-	-	-	-	(-0.449)	(0.509)
1000 seed weight (g)	-	-	-	-	-	-	-	-	-	-	-0.304
	-	-	-	-	-	-	-	-	-	-	(-0.286)

Note: Values in the column are phenotypic correlation coefficients (r_p) and those in parenthesis are genotypic correlation coefficients (r_g*, **: Significant at 5% and % level of significance respectively

Table 3: Genotypic (G) path coefficient analysis showing direct (bold) and indirect effects of different characters in Naga King Chilli

Characters	Days to first flowering	Plant height (cm)	Days to 50% fruiting	Number of fruit per plant	Fresh fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Number of fruits per cluster	Number of seeds per fruit	Dry fruit weight (g)	1000 seed weight (g)	Fruit yield per plant (g)
Days to first flowering	1.852	0.721	(0.880	-0.625	0.154	-0.052	-0.557	1.740	1.194	-0.110	-1.028	-0.984**
Plant height (cm)	0.721	17.944	4.895	-7.135	-19.229	10.354	-3.870	3.994	6.788	1.011	-12.944	0.509
Days to 50% fruiting	0.880	4.895	2.164	-3.587	-3.630	1.907	-1.538	3.019	2.953	0.514	-4.179	-0.263
Number of fruit per plant	-0.625	-7.135	-3.587	4.260	7.829	-5.148	1.959	-3.070	-3.724	-0.240	6.549	0.874**
Fresh fruit weight (g)	0.154	-19.229	-3.630	7.829	22.624	-11.645	3.401	-3.093	-6.085	-1.882	13.274	0.973**
Fruit length (cm)	-0.052	10.354	1.907	-5.148	-11.645	5.857	-1.764	2.697	3.110	0.672	-7.410	0.727*
Fruit width (cm)	-0.557	-3.870	-1.538	1.959	3.401	-1.7645	2.326	-2.099	-2.023	-0.312	3.114	0.400
Number of fruits per cluster	1.740	3.994	3.019	-3.070	-3.093	2.697	-2.099	3.977	3.875	0.520	-4.165	0.772*
Number of seeds per fruit	1.194	6.788	2.953	-3.724	-6.085	3.110	-2.023	3.875	4.189	-0.098	-6.064	0.120
Dry fruit weight (g)	-0.110	1.011	0.514	-0.240	-1.882	0.672	-0.312	0.520	-0.098	-0.051	-1.044	0.509
1000 seed weight (g)	-1.028	-12.944	-4.179	6.549	13.274	-7.410	3.114	-4.165	-6.064	-1.044	11.038	-0.286

*, **: Significant at 5% and 1% level of significance respectively
Residual effect R = 0.032 (Genotypic path)

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