RESEARCH ARTICLE

PATH ANALYSIS OF YIELD DETERMINANTS IN CHILLI (*CAPSCIUM ANNUUM* L.)

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Abstract: The experiment was conducted at research farm of IGKV, Raipur with sixteen genotypes of chilli during the rabi season of 2016-17. In the present investigation, path coefficient analysis was carried out taking fruit yield per hectare as dependent variable and rest of the sixteen characters as independent variables. The highest positive direct effect which contributed towards fruit yield per hectare was observed via fresh weight of fruits (0.891), followed by fruit yield per plant (0.856), number of primary branches (0.251), number of fruits per plant (0.200), plant height (0.150), number of seeds per fruit (0.105), dry matter % of fruits (0.104), number of pickings (0.061) and stem girth (0.017). Negative direct effects on fruit yield per ha was exhibited by fruit length (-0.479), days to first picking (-0.391), fruit girth (-0.267), days to 50 % flowering (-0.157), days to first flowering (-0.113), dry weight of fruits (-0.101) and stalk length (-0.056). The results suggested that due emphasis should be on to the genotypes that are having maximum high positive direct effect on fruit yield per hectare.

Keywords: *Capscium annuum*, Direct effect, Indirect effect, Path analysis, Yield component

INTRODUCTION

Chilli (*Capscium annuum* L.) is an important vegetable as well as condiment crop, widely grown throughout India. Chilli, also known as hot pepper, was introduced into India from Brazil during 1584 by the Portuguese. As India has the highest area under chilli, a lot of natural variability exists in this crop. Chilli is the indispensable spice, essentially used in every Indian cuisine as they provide heat, colour and flavour. It is valued for its pungency, which is due to crystalline acrid volatile alkaloid capsaicin, present in the placenta of fruits. Capsaicin has diverse prophylactic and therapeutic uses in allopathic and ayurvedic medicine. Apart from rich source of vitamin C, it contains higher amount of carotene (pro vitamin A), vitamin E, B_1 (thiamine), B_2 (riboflavin), B_3 (niacin) and small quantity of proteins, fats, carbohydrates and traces of minerals. Hence, there is need for development of new varieties and hybrids with high productivity. Knowledge of inter character relationship is very important in plant breeding for indirect selection for characters that are not easily measured. Since yield is a complex trait governed by a large number of components traits. It is imperative to know the interrelationship between yield and its component traits to arrive at an optimal selection index for improvement of yield. Wright (1921) was first to propose the path analysis to organize the relationship between the predictor and response variables. Path analysis allows separation of the direct effects of one variable from indirect effects of other variables by keeping other variables constant in order to give a clear picture of the individual contributions of each variable to yield. Therefore, path analysis is of immense significance for the breeders to study their inter relationship among characters and their influence on yield or any other dependent trait.

MATERIALS AND METHODS

The present experiment was conducted at Indira Gandhi Krishi Viswavidayalaya (IGKV), Raipur during *rabi* season of 2016-17 in order to evaluate the performance of sixteen genotypes of chilli for various yield and its component traits under field condition with three replications of each genotype in a randomized block design. The mean of five plants was used for statistical analysis. Observation recorded for characters *viz*., days to first flowering, days to 50 % flowering, plant height, number of primary branches, stem girth, days to first picking, fruit length, fruit girth, stalk length, number of seeds per fruit, number of fruits per plant, fresh weight of fruits, dry weight of fruits, dry matter % of fruits, fruit yield per plant, fruit yield per plot and number of pickings were used to study direct and indirect effects of various characters on total yield with the help of path coefficient analysis as suggested by Wright (1921).

RESULTS AND DISCUSSION

The analysis was carried out by taking fruit yield per hectare as dependent variable and rest of the sixteen characters as independent variables. The results (table-1) of the path-analysis as revealed that highest positive direct effect towards fruit yield per hectare was observed *via* fresh weight of fruits (0.891), followed by fruit yield per plant (0.856), number of primary branches (0.251), number of fruits per plant (0.200), plant height (0.150), number of seeds per fruit (0.105), dry matter % of fruits (0.104), number

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of pickings (0.061) and stem girth (0.017), whereas negative direct effects on fruit yield per ha was exhibited by fruit length (-0.479), days to first picking (-0.391), fruit girth (-0.267), days to 50 % flowering (-0.157), days to first flowering (-0.113), dry weight of fruits (-0.101) and stalk length (-0.056). Days to first flowering exhibited positive indirect effect on fruit yield per hectare through fresh weight of fruits (0.347) followed by days to first picking (0.251) and number of fruits per plant (0.055), whereas, it had negative indirect effect through days to 50 % flowering (-0.159), number of primary branches (-0.096) and fruit girth (-0.078). Days to 50 % flowering had positive indirect effect on fruit yield per hectare through days to first picking (0.281) followed by fruit length (0.111), fresh weight of fruits (0.075) and number of fruits per plant (0.038), whereas, it had negative indirect effect via fruit yield per plant (-0.119), days to first flowering (-0.114), number of primary branches (-0.104), dry matter % of fruits (-0.061), fruit girth (-0.037), plant height (-0.031) and number of seeds per fruit (-0.015). Plant height exhibited positive direct effect (0.150) with fruit yield per hectare, however the correlation between them was found to be negative due to higher magnitude of negative indirect effect fruit yield per plant (-0.248) followed by fruit length (-0.125), number of fruits per plant (-0.084), fresh weight of fruits (-0.063), days to first picking (-0.050), dry weight of fruits (-0.030), number of seeds per fruit (-0.021), stalk length (-0.015) and fruit girth (-0.004). The positive correlation value of number of primary branches with fruit yield per hectare corresponds to its positive indirect effect (0.251), whereas indirect effect 61 of number of primary branches was exhibited through fruit yield per plant (0.279), fruit girth (0.110), days to 50 % flowering (0.065), days to first flowering (0.043), plant height (0.040), number of fruits per plant (0.038), dry weight of fruits (0.029), stalk length (0.007) and number of pickings (0.003). The positive indirect effect of stem girth on fruit yield per hectare was exhibited through fresh weight of fruits (0.477), days to first picking (0.065), plant height (0.026) and dry matter % of fruits (0.015), whereas it had negative indirect effect via fruit yield per plant (-0.406), followed by fruit girth (-0.169), number of primary branches (-0.103), number of fruits per plant (-0.083), fruit length (-0.073), dry weight of fruits (-0.056), number of pickings (-0.055), days to first flowering (-0.033), days to 50 % flowering (-0.023), stalk length (-0.018) and number of seeds per fruit (-0.006). Positive indirect effect of days to first picking on fruit yield per hectare was exhibited via fruit yield per plant (0.208) followed by fresh weight of fruits (0.118), number of fruits per plant (0.030), dry weight of fruits (0.024), number of pickings (0.014), stalk length (0.003) and stem girth (0.003). The positive indirect effect of fruit length on fruit yield per hectare was exhibited via fresh weight of fruits (0.558), followed by fruit yield per plant (0.461) and number of primary branches (0.048), whereas the negative indirect effect on fruit yield per hectare was exhibited by number of fruits per plant (-0.064), followed by dry weight of fruits (-0.050), number of seeds per fruit (-0.040), number of pickings (-0.035), stalk length (-0.033) and days to first flowering (-0.010). Fruit girth had positive indirect effect on fruit yield per hectare via fresh weight of fruits (0.554), whereas the negative direct (-0.267) and indirect effect hectare was exhibited by fruit yield per plant (-0.369), number of primary branches (-0.103), number of fruits per plant (-0.098) and dry weight of fruits (-0.055), Positive indirect effect of stalk length on fruit yield per hectare was exhibited via fresh weight of fruits (0.478) followed by fruit yield per plant (0.138), plant height (0.041), days to 50 % flowering (0.037), days to first flowering (0.011), stem girth (0.006), number of seeds per plant (0.002) and dry matter % of fruits (0.001). Number of fruits per plant had positive indirect effect on fruit yield per hectare via fruit yield per plant (0.367), fruit length (0.152), fruit girth (0.130), dry weight of fruits (0.093), days to first picking (0.058), number of primary branches (0.047), number of pickings (0.032), stalk length (0.017) and number of seeds per fruit (0.004). The positive indirect effect of fresh weight of fruits on fruit yield per hectare was exhibited via followed by fruit yield per plant (0.125) and days to first picking (0.052). Dry weight of fruits had positive indirect effect on fruit yield per hectare via dry matter % of fruits (0.076), days to 50 % flowering (0.051), plant height (0.044), stem girth (0.009) and days to first flowering (0.003). Number of pickings exhibited positive indirect effect on fruit yield per hectare through fruit length (0.274), fruit girth (0.213), fruit yield per plant (0.205), number of fruits per plant (0.104), days to first picking (0.090), dry weight of fruits (0.067), plant height (0.045), days to first flowering (0.043), stalk length (0.021), number of primary branches (0.012), number of seeds per fruit (0.006). Positive indirect effect of dry matter % of fruits on fruit yield per hectare was exhibited via fresh weight of fruits (0.116) followed by days to 50 % flowering (0.092), plant height (0.083), days to first flowering (0.049), number of seeds per plant (0.003) and stem girth (0.002). Fruit yield per plant had positive indirect effect on fruit yield per hectare via fresh weight of fruits (0.130) followed by fruit girth (0.115), days to first picking (0.095), number of fruits per plant (0.086), number of primary branches (0.082), days to 50 % flowering (0.022), dry weight of fruits (0.022), number of pickings (0.015) and days to first flowering (0.003). The above findings of path studies are in accordance with the findings of Sharma *et al.* (2010) for number of fruits per plant, Datta and Jana (2010) for primary branches and number of fruit per plant, Sarkar *et al.* (2009) for fruit weight, Reddy *et al.* (2008) reported high maximum direct effect on fruit yield per plant plant height, number of fruits per plant, average fruit weight, and number of seeds per

fruit. Sahu *et al* (2016) also reported same result *i.e.* highest positive direct effect which contributed towards fruit yield per hectare was fresh weight of fruit, fruit yield per plant, number of primary branches, number of fruits per plant, plant height, number of pickings and stem girth.

Table 1. Direct and indirect effect of component character on fruit yield in chilli

Characters	Days to first flowering	Days to 50 % flowering	Plant height (cm)	Number of primary branches	Stem girth (cm)	Days to first picking	Fruit length (cm)	Fruit girth (cm)	Stalk length (cm)	Number of seeds per fruit	Number of fruits per plant	Fresh weight of fruits (gm)	Dry weight of fruits (gm)	Number of pickings	Dry matter % of fruits	Fruit yield per plant (gm)	Correlation coefficient with fruit yield per ha
Days to first flowering	**-0.113**	-0.159	-0.013	-0.096	0.005	0.251	-0.043	-0.078	0.005	-0.023	0.055	0.347	0.003	-0.023	-0.045	-0.037	0.037
Days to 50 % flowering	-0.114	**-0.157**	-0.031	-0.104	0.002	0.281	0.111	-0.037	0.013	-0.015	0.038	0.075	0.033	0.006	-0.061	-0.119	-0.078
Plant height (cm)	0.010	0.032	**0.150**	0.067	0.003	-0.050	-0.125	-0.004	-0.015	-0.021	-0.084	-0.063	-0.030	0.018	0.057	-0.284	-0.338*
Number of primary branches	0.043	0.065	0.040	**0.251**	-0.007	-0.167	-0.091	0.110	0.007	-0.014	0.038	-0.249	0.029	0.003	-0.003	0.279	0.334*
Stem girth (cm)	-0.033	-0.023	0.026	-0.103	**0.017**	0.065	-0.073	-0.169	-0.018	-0.006	-0.083	0.477	-0.056	-0.055	0.015	-0.406	-0.425**
Days to first picking	-0.072	-0.113	-0.019	-0.107	0.003	**0.391**	-0.052	-0.037	0.003	-0.050	0.030	0.118	0.024	0.014	-0.058	0.208	0.283
Fruit length (cm)	-0.010	0.036	0.039	0.048	0.003	0.042	**-0.479**	0.002	-0.033	-0.040	-0.064	0.558	-0.050	-0.035	0.017	0.461	0.495**
Fruit girth (cm)	-0.033	-0.022	0.002	-0.103	0.011	0.054	0.003	**-0.267**	-0.001	-0.028	-0.098	0.544	-0.055	-0.049	0.025	-0.369	-0.385**
Stalk length (cm)	0.011	0.037	0.041	-0.034	0.006	-0.024	-0.282	-0.007	**-0.056**	0.002	-0.060	0.478	-0.040	-0.023	0.001	0.138	0.187
Number of seeds per fruit	-0.025	-0.023	0.030	0.034	0.001	0.187	-0.185	-0.071	0.001	**-0.105**	-0.008	0.212	-0.006	-0.004	-0.003	0.378	0.415**
Number of fruits per plant	-0.031	-0.030	-0.063	0.047	-0.007	0.058	0.152	0.130	0.017	0.004	**0.200**	-0.523	0.093	0.032	-0.087	0.367	0.361*
Fresh weight of fruits (gm)	-0.044	-0.013	-0.011	-0.070	0.009	0.052	-0.300	-0.163	-0.030	-0.025	-0.118	**0.891**	-0.075	-0.063	0.014	0.125	0.179
Dry weight of fruits (gm)	0.003	0.051	0.044	-0.071	0.009	-0.094	-0.236	-0.145	-0.022	-0.006	-0.185	0.661	**-0.101**	-0.041	0.076	-0.185	-0.243
Number of pickings	0.043	-0.014	0.045	0.012	-0.015	0.090	0.274	0.213	0.021	0.006	0.104	-0.920	0.067	**0.061**	-0.004	0.205	0.188
Dry matter % of fruits	0.049	0.092	0.083	-0.007	0.002	-0.219	-0.078	-0.065	0.000	0.003	-0.168	0.116	-0.074	-0.002	**0.104**	-0.377	-0.542**
Fruit yield per plant (gm)	0.005	0.022	-0.050	0.082	-0.008	0.095	-0.258	0.115	-0.009	-0.046	0.086	0.130	0.022	0.015	-0.046	**0.856**	0.954**

*Diagonal bold numbers shows direct effect (positive or negative) of characters on fruit yield per hectare

CONCLUSION

On the basis of above findings, it can be suggested that selection for traits fresh weight of fruits, followed by fruit yield per plant, number of primary branches, number of fruits per plant and number of seeds per fruit due to possessed highly positive direct effect on fruit yield. Negative direct effects on fruit yield per hectare was exhibited by fruit length followed by days to first picking, fruit girth, days to 50 % flowering, days to first flowering, dry weight of fruits and stalk length. Result obtained from path analysis suggests that while improving fruit yield per hectare in chilli, characters namely fresh weight of fruits, followed by fruit yield per plant, number of primary branches, number of fruits per plant and number of seeds per fruit may be considered as key traits. The above findings of path studies are in accordance with the findings of Vani *et al.* (2007) and Farhad *et al.* (2008), reported same result *i.e* highest positive direct effect towards fruit yield per hectare was number of fruits per plant and average fruit weight.

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