

Original Research Article

<https://doi.org/10.20546/ijcmas.2020.907.091>

Cause and Effect Relationship to Identify Important Yield Contributing Traits in Saffron (*Crocus sativus* L.)

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A B S T R A C T

Keywords

Saffron, variable, direct effect, indirect effect, path coefficient analysis

Article Info

Accepted:

08 June 2020

Available Online:

10 July 2020

The present investigation was carried out at Saffron Research Station Pampore, (SKUAST-K) during Rabi 2017-18. Observations were recorded on 10 randomly selected and tagged competitive plants for eighteen (18) morphological, floral and corm traits viz, number of flowers line⁻¹, number of days to 50% flowering, total flower weight corm⁻¹, inner tepal length, outer tepal length, inner tepal width, outer tepal width, anther length, anther width, style length, stigma length, fresh pistil weight line⁻¹, leaf length, dry pistil weight line⁻¹, number of leaves corm⁻¹line⁻¹, number of days to 50% sprouting, big Corm Index and multiplication index. The path analysis revealed that stigma length and flower weight recorded highest direct effect towards dry pistil weight followed by number of flowers per corm per line, fresh pistil weight and big corm index. Rest of the traits as recorded the negative direct effect of multiplication index, number of days to 50% flowering, number of days to 50% sprouting on the dependant variable.

Introduction

Saffron (*Crocus sativus* L.) belongs to family *Iridaceae* is the most expensive spice in the world and is popularly known as the “Golden Condiment”. In India it is a legendary crop of Jammu and Kashmir, produced on well drained karewa soils, where ideal climatic conditions are available for good shoot growth and flower production.

The genus *Crocus* includes native species from Europe, North Africa and temperate Asia, and is especially well represented in

arid countries of South-Eastern Europe and Western and Central Asia (Fernández, 2004). Dried stigmas of saffron flowers compose the most expensive spice which has been valuable since ancient times for its odoriferous, coloring, and medicinal properties (Plessner *et al.*, 1989).

The possibility of saffron genetic improvement is indicated through clonal selection from the available germplasm resources. Identification of these elite genotypes with distinct superiority in yield and corm attributes can be used as a source

for further improvement and development of high yielding varieties which would be beneficial for saffron industry in Jammu and Kashmir. Corm, foliar structure and floral organs constitute main parts of saffron plants (Nehvi and Salwee, 2010). The flower has an underground ovary, a style 5 to 9 cm long dividing at the top into three red trumpet like stigmas (2 to 3 cm long) which when dried, form the commercial spice "saffron". Saffron is the crop of great economic significance due to its great demand and value in the world market for its multiple uses in diversified fields. The knowledge on the extent of variation and identification of a good number of genotypes as potential donors in yield improvement programme is essential. For the most efficient mobilization of available germplasm resources, it is vital to have better understanding of the nature and magnitude of genetic variability, character association and their direct and indirect effect on yield and other traits. Consequently, the more we know of the true relationship among the variables, the more meaningful will be the result of path analysis. The technique has been employed to study the direct and indirect effect of various traits on the ultimate product of economic importance in several crops.

Materials and Methods

Saffron corms weighing 5g to 16g were planted in Augmented Block Design, for daughter corm production under annual planting cycle. Corms were planted under each category supplemented with adequate nutrients. The material for study comprised of 140 saffron germplasm collected from different saffron growing areas of Kashmir and abroad. The pedigree details of all the 140 corm samples was recorded and subsequently planted in Augmented Block Design with a row length of 3m, width 1.5m and inter and intra-row spacing of 20 and 10 cms, respectively. Observations were recorded on

10 randomly selected and tagged competitive plants from each line for all the traits during the crop year 2017-2018.

Floral attributes

Number of flowers corm⁻¹line⁻¹, Number of flowers corm⁻¹ line⁻¹, Total flower weight corm⁻¹, Outer tepal length, Inner tepal length (cm), Outer tepal width (cm), Inner tepal width (cm), Anther length (cm), Anther width (mm), Style length (cm), Stigma length (cm), Fresh pistil weight per line (mg), Dry pistil weight per line (mg).

Vegetative parameters

Leaf length (cm), No. of leaves per line

Corm attributes

No. of days to 50% sprouting, Big Corm Index, Multiplication index.

Results and Discussion

The present investigation was carried out to generate information on cause and effect relationship for 18 floral, corm and morphological attributes. The results obtained through various biometrical/statistical procedures and the inferences drawn regarding various parameters are described in respect of cause and effect relationship.

Cause and effect relationship

If the cause and effect relation is well defined, it is possible to represent the whole system of variables in the form of a diagram as depicted in Figure 1. Here direct and indirect effects of eighteen different yield attributing traits towards dry pistil weight were estimated through partitioning of their genotypic correlation coefficients using path coefficient analysis.

Table.1 Direct (diagonal) and Indirect (off-diagonal) effects of important traits on Fresh pistil weight (mg) in saffron (*Crocus sativus* L.)

Traits	OTL	ITL	OTW	ITW	STGL	STYL	LFL	L/C/L	F/C/L	FWT/C/L	BCI	MI	FPW	DPW	AL	AW	50%F	50%S	DPW
OTL	0.6313	-0.1314	0.3434	0.5578						0.4732	0.5325	-0.4042	0.4942	0.2885	0.3077	0.4489	-	-	0.2885
ITL			0.1037	0.1416	0.3298	0.1440	0.4169	0.6313	0.4215	0.0330	0.0297	0.0838	-0.0251	0.1272	0.0928	0.0583	-	-	0.1272
OTW				0.3218	0.0979	0.0292	0.0060	0.0403	0.0197	0.2159	0.2467	-0.3866	0.2779	0.2406	0.2634	0.4229	-	-	0.2406
ITW					0.4654	0.1544	0.2354	0.3268	0.2540	-0.4148	0.5003	-0.4847	0.4058	0.2482	0.3750	0.5786	-	-	0.2482
STGI					0.4500	0.2591	0.4843	0.5588	0.4097	-0.3763	0.3970	-0.4694	0.3873	0.2966	0.4788	0.6312	-	-	0.2966
STYL						0.2019	0.4303	0.3960	0.3763	0.0779	0.1381	-0.1790	0.0585	0.1018	0.2429	0.3539	-	-	0.1018
LFL							0.1514	0.0994	0.0847	0.6105	0.6759	-0.4646	0.6284	0.4080	0.5091	0.6456	-	-	0.4080
L/C/L								0.6991	0.6099	0.7970	0.7389	-0.4267	0.8212	0.5182	0.6464	0.6255	-	-	0.5182
F/C/L									0.8074	0.9122	0.7355	-0.5173	0.9247	0.6699	0.5750	0.6638	-	-	0.6699
FWT/L											0.7532	-0.5659	0.9137	0.6604	0.4938	0.6577	-	-	0.9137
BCI												-0.5490	0.7799	0.5575	0.5514	0.6747	-	-	0.5575
MI													-0.5300	-0.2663	-0.3467	-0.6452	0.2469	-	-0.2663
FPW															0.8713	0.5315	0.6575	-	0.6855
DPW															0.4038	0.4718	-	-	1.0000
AL																0.6109	-	-	0.4038
AW																	-	-	0.4718
50%F																	0.5610	-	-0.3832
50%S																		0.4712	-0.1883

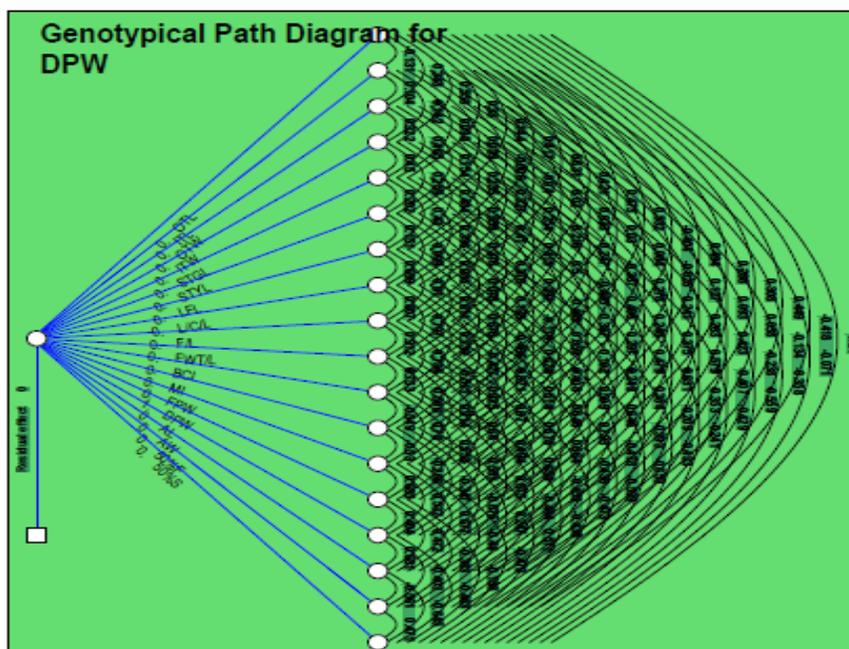


Fig.1 Genotypical Path Diagram for DPW

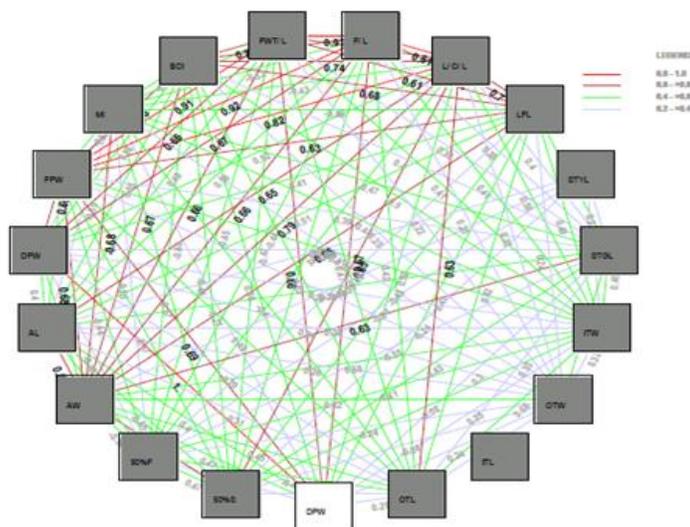


Fig.2 Genotypical Correlations

At genotypic level, results are presented in Table 1 and depicted in Figure 1. Maximum positive direct effect of stigma length (0.94) to dry pistil weight was observed which contributed to the strong association. Stigma length, flower weight also has positive direct effect on dry pistil weight. The multiplication

index, number of days to 50% flowering and number of days to 50% sprouting has a strong indirect negative effect on dry pistil weight.

Path coefficient analysis revealed residual variance of 0.61 indicating thereby that 89% variance was accounted for by path analysis.

Based on the prior knowledge of casual relationship between independent and dependent variables, a casual scheme was formulated. In this scheme stigma length, flower weight, number of flowers per corm per line, fresh pistil weight and big corm index were taken as independent variables and their contribution towards dry pistil weight (dependent trait) was determined. The analysis revealed that stigma length recorded highest direct effect towards dry pistil weight followed by number of flowers per corm per line, fresh pistil weight and big corm index. Rest of the traits as recorded weak positive direct effects. The weak direct effect of tepal length and width, style length and leaf length was nullified on account of strong indirect effect via stigma length that means the negative direct effect was nullified by the positive effect of morphological independent traits as also studied earlier by Sheikh *et al.*, 2014.

An attempt was made to generate information on direct and indirect effect of various attributes on saffron yield. The estimates of residual variability measured in terms of residual effect indicated that most of the traits were considered in the evaluation of selective potential of present set of materials and explain the relationship of these traits with saffron yield. Path coefficient analysis in gladiolus by Sandhu *et al.*, revealed that flower size and duration of flowering recorded maximum direct effect on yield whereas Hedge *et al.*, Anuradha *et al.*, and Neraj *et al.*, recorded maximum positive direct effect by plant height in various crops.

Based on findings of present investigation, possibility of saffron improvement is indicated through clonal selection from the available germplasm resource. Identification of six (6) elite genotypes which are extreme (distinct superiority) in certain traits can act as a source for further improvement and

development of high yielding varieties which can be beneficial for saffron industry in Jammu and Kashmir. Development of varieties from the identified germplasm resources, exhibiting high yielding potential will boost the production and productivity of saffron in Jammu and Kashmir State and improve the socio-economic wellbeing of the people associated with this important commercial crop and can be further investigated by future researchers working for the improvement of saffron.

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How to cite this article:

Mohammad Irfan, Sabina Nasseer, Uzma Rashid and Ashraf Bhat. M. 2020. Cause and Effect Relationship to Identify Important Yield Contributing Traits in Saffron (*Crocus sativus* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(07): 794-799. doi: <https://doi.org/10.20546/ijcmas.2020.907.091>