The Pharma Innovation Journal 2023; 12(7): 2506-2509

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(7): 2506-2509

www.thepharmajournal.com
Received: 20-05-2023
Accepted: 26-06-2023

Vageeshvari
Department of Genetics & Plant Breeding, IGKV, Raipur, Chhattisgarh, India

Rajeev Shrivastava
Department of Genetics & Plant Breeding, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Vageeshvari
Department of Genetics & Plant Breeding, IGKV, Raipur, Chhattisgarh, India

Association analysis in safflower (*Carthamus tinctorius* L.) for yield and its contributing traits

Vageeshvari and Rajeev Shrivastava

Abstract
The experiment conducted in three successive year's during *rabi* 2020-21, *rabi* 2021-22 and *rabi* 2022-23 at Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G.) for estimation of correlation between yield and its component to study their direct and indirect effect on seed yield and oil content % in safflower (*Carthamus tinctorius* L.). Eleven morphological and qualitative traits were analyzed for phenotypic correlation among the traits as well as their direct and indirect effect. The correlation analysis results indicated that seed yield showed a positive significant association with harvest index % at phenotypic level which indicated that these traits are helpful in direct selection to improve the expansion of seed yield of safflower. The harvest index percent, biological yield per plant, days to maturity, plant height (cm), and number of primary branches per plant all had the greatest positive direct effects on seed yield, whereas days to 50% flowering, 100 seed weight, number of capitulum per plant, oil content (%) and number of seeds per capitulum showed negative direct effects. These suggested that breeding efficiency for seed yield in safflower will be improved by direct selection for these traits.

Keywords: Safflower, correlation and path analysis

Introduction
The world's most important oilseed crop, safflower is an *Asteraceae* or *Compositae* member that originated in Afghanistan and Ethiopia (the Middle East). The safflower (*Carthamus tinctorius* L.), one of only 25 species in the genus *Carthamus*, is a diploid (2n=24) annual herbaceous crop that thrives in hot, dry climates. Safflower is occasionally referred to in Sanskrit literature as "*Kusum*" and "*Agnisikha"* The Latin word "*Carthamus*" is the translation of the Arabic word "*Quartum*" or "*Gurtum*" which describes the colour of the dye produced from safflower flowers. Its use as a less expensive saffron substitute is indicated by the fake names saffron, bastard saffron, thistle saffron, and dyer's saffron (Weiss, 1971) [10]. Oleic acid, a monounsaturated fatty acid and linoleic acid, a polyunsaturated fatty acid, are both present in safflower oil. Correlation coefficients, in general, reflect the strength of linear relationships and correlations between independent features. However, as correlation coefficients can only give a primitive explanation of relationships, path analysis is made to comprehensively expose links between features. Path coefficient analysis separates the total correlation coefficient into direct affects and indirect effects via other linked characters. The components and interactions of the yield have a big impact on safflower breeding. (Purkaystha and Shrivastava, 2020) [4].

Materials and Methods
The current study, which used 25 safflower genotypes including four check varieties PBNS-12, JSI-99, DSH-185, and A-1 was conducted in *rabi* 2020–2021, *rabi* 2021–22, and *rabi* 2022–23 at IGKV, Raipur, Chhattisgarh mainly focused on assessment of yield and its contributing characters in Safflower (*Carthamus tinctorius* L.) Three replications of the Randomized Block Design (RBD) were used to set up the experiment. The ideal growth stage of five plants from each plot were chosen at random in order to collect data on various yield and yield-contributing characters.

Result and Discussion
The relationship between yield and the traits that affect it was discovered to be a significant predictor of the success of parent selection as a breeding strategy to increase both plants and economic output. The degree of association has an effect on the primary goal of crop breeding efforts, which is to create higher yields. Genotypic association may be attributed to the

pleiotropic behaviour of the genes or their linkage, most likely both. The phenotypic correlation, which takes into account both genotypic and environmental factors, reveals the whole interplay of all the distinct features. Any potential phenotypic and genotypic consolidations associated with significant features have been examined.

Plant height exhibited significant positive correlation with number of capitulum per plant (0.281*) and days to 50% flowering trait exhibited highest positive and significant correlation with days to maturity (0.482**) and positive and significant correlation with plant height (0.235*). Number of primary branches per plant exhibited significant positive correlation with number of capitulum per plant (0.281*) and oil content % (0.262*) whereas significant negative association with harvest index % (-0.264*) whereas number of capitulum per plant has significant positive association with oil content % (0.350*) and number of seeds per capitulum (0.350*). Number of seeds per capitulum has highly significant positive association with oil content % (0.455**) whereas significant negative correlation with 100 seed weight (-0.357*) and biological yield per plant (g) showed highly significant negative association with harvest Index (%) (-0.773**) whereas oil content (%) exhibited negative and significant correlation with harvest Index (%) (-0.258*) and 100 seed weight has significant negative association with oil content % (-0.290*). Harvest index (%) exhibited highly positive and significant correlation with seed yield per plant (0.485**) which indicated that direct selection of this trait is useful for increase the seed yield. Seed yield per plant has positive and significant association with harvest index % (0.485**) (Table 1). These traits are helpful in direct selection to improve the expansion of seed yield of safflower. This is in agreement with earlier findings of Pushpavalli and Kumar (2017) [5], Tandekar and Shrivastava (2018) [8], Dhruw *et al.,* (2022) [1], Pillai and Shrivastava *et al.,* (2023) [3] and Verma *et al.,* (2023) [9].

In Path analysis the positive direct effect was recorded with highest positive direct effect was recorded with biological yield per plant (1.213), plant height (cm) (0.873), harvest index % (0.815) days to maturity (0.113) and number of primary branches per plant (0.074) but days to 50% flowering (-0.202), 100 seed weight (-0.115), number of capitulum per plant (-0.076), Oil content (%)(-0.074) and number of seeds per capitulum (-0.019) were showed negative direct effect on seed yield. These findings are in conformity with Tandekar and Shrivastava (2018) [8], Pillai and Shrivastava *et al.,* (2023) [3], (Table 2). The investigation results indicated that the character harvest index %, biological yield per plant, number of primary branches per plant and number of seeds per capitulum and days to maturity were demonstrated that greater direct positive effects and indirect effects through other component features. These suggested that breeding efficiency for seed yield in safflower will be improved by direct selection for these traits. Therefore, it would be imperative for a plant breeder working to increase safflower production to place the greatest focus on the aforementioned traits.

An utilizing oil content as a dependent variable, path coefficient analysis was actively employed to calculate the association coefficient for both direct and indirect influences among them. (Table 3). The highest positive direct effect was recorded with plant height (0.417) followed by number of seeds per capitulum (0.215), biological yield per plant (0.183), number of primary branches per plant (0.102), number of capitulum per plant (0.090) and harvest index% (0.021). This implies that the correlation revealed represents an actual relationship and that the direct selection method will work well with these characters. This implies that a modest increase in one of the aforementioned characteristics may immediately affect the quantities of oil present. Present findings were also in conformity with those of Shivani *et al.,* (2010) [7], Golkar *et al.,* (2011) [2]. The direct negative influence were observed for 100 seed weight (-0.219), seed yield per plant (-0.183), days to 50% flowering (-0.030) and days to maturity (-0.019) were showed negative direct effect on oil content (%). These are in agreement with earlier findings of, Pushpavalli and Kumar (2017) [5], Tandekar and Shrivastava (2018) [8], Pillai and Shrivastava *et al.,* (2023) [3] and Verma *et al.,* (2023) [9].

The investigation results indicated that the seed yield per plant has positive and significant association with harvest index %. These traits are helpful in direct selection to improve the growth of seed yield of safflower. Study of direct and indirect effect on seed yield revealed that the character harvest index %, biological yield per plant, number of primary branches per plant and number of seeds per capitulum and days to maturity showed that higher direct positive effects and indirect effects. Similar oil content (%) exhibited negative and significant correlation with harvest Index (%). These suggested that breeding efficiency for seed yield in safflower will be improved by direct selection for these traits. Therefore, it would be imperative for a plant breeder working to increase safflower production to place the greatest focus on the aforementioned traits. The breeding effectiveness for seed yield in safflower will be improved by direct selection for these features.

Table 1: Pooled correlation study for yield and its contributing traits in safflower *rabi* 2020-21, 2021-22 and 2022-23

Traits		DM	PH (cm)	NPB	NCP	NSC	BYPP (g)	100SW (g)	OC (%)	HI (%)	SYPP (g)
DFF	G	0.676**	0.232*	0.080	-0.049	-0.048	0.150	0.138	0.063	-0.266*	-0.327*
	P	0.482**	0.235*	-0.029	-0.047	0.051	-0.044	-0.057	0.080	0.002	-0.096
DM	G	1.000	0.341*	-0.190	0.138	0.193	0.073	0.194	0.144	-0.082	-0.088
	P	1.000	0.089	-0.184	-0.008	0.103	-0.063	-0.077	0.014	0.091	0.006
PH (cm)	G		1.000	-0.055	0.249*	0.261*	0.130	0.041	0.499**	-0.234*	-0.181
	P		1.000	0.160	0.259*	0.337*	0.093	-0.046	0.564**	-0.169	-0.136
NPB	G			1.000	-0.029	-0.074	0.131	-0.032	0.117	-0.275*	-0.214
	P			1.000	0.281*	0.066	0.134	-0.041	0.262*	-0.264*	-0.161
NCP	G				1.000	0.222	0.203	-0.062	0.364*	-0.252*	-0.183
	P				1.000	0.248*	0.196	-0.140	0.350*	-0.185	-0.030
NSC	G					1.000	-0.206	-0.112	0.363*	0.055	-0.170
	P					1.000	-0.126	-0.357*	0.455**	0.022	-0.087
BYPP (g)	G						1.000	0.026	0.238*	-0.830**	-0.049

	P						1.000	0.179	0.161	-0.773**	0.086
100SW (g)	G							1.000	-0.212	-0.046	-0.134
	P							1.000	-0.290*	-0.170	-0.098
OC (%)	G								1.000	-0.367*	-0.283*
	P								1.000	-0.258*	-0.175
HI (%)	G									1.000	0.528**
	P									1.000	0.485**

P = Phenotypic correlation, G = Genotypic correlation, *,** Significance at 5% and 1% levels, respectively
DFF = Days to 50% flowering, DM = Days to maturity, PH (cm) = Plant height (cm), NPB = No. of primary branches/plant, NECP = No. of capitulum/plant, NSC = Number of seeds /capitulum, BYPP (g) = Biological yield /plant (g), 100 SW (g) = 100 seed weight (g), OC (%) = Oil content (%), HI (%) = Harvest index (%), SYPP (g) = Seed yield /plant (g)

Table 2: Pooled path analysis for yield and its contributing traits in safflower *rabi* 2020-21, 2021-22 and 2022-23 when seed yield as dependent traits

	DFF	DM	PH (cm)	NPB	NECP	NSC	BYPP (g)	100SW (g)	OC (%)	HI (%)	SYPP (g)
DFF	-0.202	-0.137	-0.047	-0.016	0.010	0.010	-0.030	-0.028	-0.013	0.054	-0.327*
DM	0.077	0.113	0.039	-0.022	0.016	0.022	0.008	0.022	0.016	-0.009	-0.088
PH (cm)	0.020	0.030	0.087	-0.005	0.022	0.023	0.011	0.004	0.044	-0.020	-0.181
NPB	0.006	-0.015	-0.004	0.077	-0.002	-0.006	0.010	-0.003	0.009	-0.021	-0.214
NECP	0.004	-0.011	-0.019	0.002	-0.077	-0.017	-0.016	0.005	-0.028	0.019	-0.183
NSC	0.001	-0.004	-0.005	0.001	-0.004	-0.020	0.004	0.002	-0.007	-0.001	-0.170
BYPP (g)	0.182	0.088	0.157	0.159	0.246	-0.250	1.213	0.032	0.289	-1.007	-0.049
100SW (g)	-0.016	-0.022	-0.005	0.004	0.007	0.013	-0.003	-0.116	0.025	0.005	-0.134
OC (%)	-0.005	-0.011	-0.037	-0.009	-0.027	-0.027	-0.018	0.016	-0.074	0.027	-0.283*
HI (%)	-0.393	-0.121	-0.347	-0.407	-0.373	0.081	-1.229	-0.068	-0.543	0.815	0.528**

*, ** Significance at 5% and 1% levels, respectively
DFF = Days to 50% flowering, DM = Days to maturity, PH (cm) = Plant height (cm), NPB = No. of primary branches/plant, NECP = No. of capitulum/plant, NSC = Number of seeds /capitulum, BYPP (g) = Biological yield /plant (g), 100SW (g) = 100 seed weight (g), OC (%) = Oil content (%), HI (%) = Harvest index (%), SYPP (g) = Seed yield /plant (g)

Table 3: Path analysis for yield and its contributing traits in safflower *rabi* 2020-21, 2021-22 and 2022-23 when oil content as dependent traits

	DFF	DM	PH (cm)	NPB	NECP	NSC	SYPP (g)	BYPP (g)	100SW (g)	HI (%)	OC (%)
DFF	-0.031	-0.015	-0.007	0.001	0.001	-0.002	0.003	0.001	0.002	0.000	0.080
DM	-0.009	-0.019	-0.002	0.004	0.000	-0.002	0.000	0.001	0.002	-0.002	0.014
PH (cm)	0.098	0.037	0.418	0.067	0.108	0.141	-0.057	0.039	-0.019	-0.071	0.564**
NPB	-0.003	-0.019	0.016	0.102	0.029	0.007	-0.016	0.014	-0.004	-0.027	0.262*
NECP	-0.004	-0.001	0.023	0.025	0.090	0.022	-0.003	0.018	-0.013	-0.017	0.350*
NSC	0.011	0.023	0.075	0.015	0.055	0.222	-0.019	-0.028	-0.079	0.005	0.455**
SYPP (g)	0.012	-0.001	0.018	0.021	0.004	0.011	-0.130	-0.011	0.013	-0.063	-0.175
BYPP (g)	-0.008	-0.012	0.017	0.025	0.036	-0.023	0.016	0.183	0.033	-0.142	0.161
100SW (g)	0.013	0.017	0.010	0.009	0.031	0.078	0.022	-0.039	-0.220	0.037	-0.290*
HI (%)	0.000	0.002	-0.004	-0.006	-0.004	0.001	0.010	-0.017	-0.004	0.021	-0.258*

Residual effect 0.705
*, ** Significance at 5% and 1% levels, respectively
DFF = Days to 50% flowering, DM= Days to maturity, PH (cm) = Plant height (cm), NPB = No. of primary branches/plant, NECP = No. of capitulum/plant, NSC = Number of seeds /capitulum, BYPP (g) = Biological yield /plant (g), 100 SW (g) = 100 seed weight(g), OC (%) = Oil content (%), HI (%) = Harvest index (%), SYPP (g) = Seed yield /plant (g)

References

1. Dhruw P, Chandrakar P, Shrivastava R. Assessment of genetic variability, heritability and genetic advance for seed yield and its contributing traits in elite germplasm accessions of safflower (*Carthamus tinctorius* L.). Pharma Innovation J. 2022;11(1):311-313.
2. Golkar P, Arzani A, Rezaei AM. Determining relationships among seed yield, yield components and morpho-phenological traits using multivariate analyses in safflower (*Carthamus tinctorious* L.). Ann. Bio. Res. 2011;2(3):162-169.
3. Pillai A, Shrivastava R. Correlation and path analysis of seed yield and its contributing traits in safflower (*Carthamus tinctorius* L.) genotypes. Pharma Innovation J. 2023;12(4):707-709.
4. Purkaystha S, Srivastava R. Study on correlation and path analysis in F2 population in safflower. J Pharmacogn. Phytochem. 2020;9(1):1652-1655.
5. Pushpavalli SNCVL, Kumar G. Study of genetic variability, correlation and path analysais of safflower genotypes. Res. J Agril. Sci. 2017;8(3):706-709.
6. Sahoo Bhaskar C, Shrivastava R, Odhar H. Determination of optimum plant characters in safflower (*Carthamus tinctorius* L.) under rice based late sown condition. Electronic J of Plant Breeding. 2022;(13(1):225-229.
7. Shivani D, Sreelakshmi C, Kumar CV. Heterosis and inbreeding depression for yield and yield components in safflower (*Carthamus tinctorius* L.). EJPB. 2010;1(6):1492-1494.
8. Tandekar K, Shrivatava R. Study of genetic variability, correlation and path analysis in safflower (*Carthamus tinctorious* L.) J Agric. 2018;23(1):53-58.
9. Verma S, Rao SS, Shrivastava R. Correlation and path

analysis in safflower (*Carthamus tinctorius* L.). The Pharma Innovation J. 2023;12(2):3001-3003.
10. Weiss EA. Castor, Sesame and Safflower. United Kingdom: Barnes & Noble. 1971.
11. Yadav P, Shrivastava R. Inheritance studies, detection and estimation of linkage of various important qualitative traits in safflower (*Carthamus tinctorius* L.). Pharma Innovation J. 2023;15(1):206-25.