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To assess association correlation in mid-season cauliflower (*Brassica oleracea var. botrytis* L.)

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Abstract
The investigation entitled "Association and Path analysis in mid-season cauliflower" was carried out in the field of All India Co-ordinated Research Project on Vegetable crops (AICRP), Horticulture Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during *Rabi* season 2021-2022. The range, mean, phenotypic and genotypic coefficient of variation, correlation coefficient were estimated. Hence, twelve genotypes were planted in randomized block design replicated thrice. Observation in respect of yield and growth parameters were recorded on five random plants from each replication. Genotype 2020/CAUMHYB-1 and 2020/CAUMHYB-2 both are statistically best performed in terms of marketable curd yield per plot but as far as other significant characters associated directly towards yield is computed, it showed clear superiority of genotype 2020/CAUMHYB-1 over 2020/CAUMHYB-2.

Keywords: Cauliflower, genotypes, yield, correlation

Introduction
Cauliflower (*Brassica oleracea var. botrytis* L.) is a member of the Brassicaceae family. Cauliflower derived its name from two Latin words: caulis means cabbage and Floris, which means flowers. Brassica oleracea varieties have an equal number of chromosomes, n=9 (Thamburaj and Singh, 2001) [8]. Cauliflower is a cross-pollinated crop due to self-incompatibility and protogyny. All cultivars of cole vegetables are thought to have evolved from *Brassica oleracea var. sylvesteris* L., also known as wild cabbage and resembling a leafy kale plant. *Brassica cretica* is thought to be the ancestor of cauliflower (Muthukumar and Selvakumar, 2013) [5].
Curd is the edible part of a cauliflower that is botanically known as the pre- floral fleshy apical meristem or immature inflorescence. Cauliflower is the only cole crop in which the vegetative and reproductive stages are separated by an intermediate stage (Nieuwhof, 1969) [6]. Cauliflower is a nutrient-rich vegetable. Carbohydrates, protein, ascorbic acid, and minerals such as potassium, phosphorus, calcium, salt, and magnesium are all found in it.
Cauliflower is divided into four maturation groups in Northern India: I – matures from late August to early November, II – matures from mid-November to early December, III – matures from mid-December to early January, and IV – matures from mid-January to early March.
In India cauliflower is grown on an area of 458 thousand ha with production of 8840,000 MT and productivity is 19.30 MT/ha (Anon.2020) [1]. In Chhattisgarh cauliflower grown on an area of 23.817 thousand ha and production is 475.47 thousand MT and productivity is 19.96 MT/ha (Anon.2021-2022) [2].
Considering all the possibilities for improvement of cauliflower crop, an attempt was made to find out Association and Path analysis in mid-season cauliflower.

Material and Methods
The experiment was laid out at Horticulture Research cum Instructional Farm, Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during *Rabi* season 2021-2022. Geographically the farm is situated between 22˚33'N and to 21˚14'N latitude and 82˚6'E to 81˚38'E longitude, at a height of 289.56 meters above mean sea level. The soil was clay loam with good drainage and adequate water holding capacity. Twelve genotypes were raised in Randomized Block Design (RBD) with three Replication.
Five competitive and healthy plants from each plot of each replication were randomly selected for the purpose of recording observations on various quantitative traits and their mean values were used in the statistical analysis.

The genotypes were studied for various yield related traits *viz*. plant height (cm), number of leaves per plant, leaf length (cm), leaf width (cm), stalk length (cm), days to marketable curd maturity from DAT, curd width (cm), curd length (cm), curd depth (cm), number of leaves attached to curd, gross weight of the plant (g), marketable yield per plant (g), marketable yield per plot (kg), duration of crop from date of sowing to last harvest.

The data of different parameters collected during the period of experiment were subjected to statistical analysis as per method of analysis of variance by Panse and Sukhatme (1978) [7].

Results and Discussion

The analysis of variance depicted that most of the traits studied under the present experiment exhibited significant mean sum of squares and indicating that there was enough variability among the genotypes. The mean performance of different parameters with respect to genotypes are presented in table 1.

The maximum value for plant height was recorded for genotype 2020/CAUMHYB-2 (50.73 cm) while minimum plant height was recorded for genotype 2019/CAUMHYB-5 (34.87 cm). Highest number of leaves per plant was recorded for genotype 2020/CAUMHYB-1 (21.90) whereas lowest value was recorded for 2019/CAUMHYB-4 (15.53). The maximum leaf length was recorded in 2020/CAUMHYB-5 (28.33 cm) whereas minimum leaf length was recorded in 2020/CAUMHYB-5 (22.96 cm). The maximum leaf width was noted in 2020/CAUMHYB-4 (19.03 cm) whereas the minimum leaf width was noted in 2019/CAUMHYB-6 (13.88 cm).

Maximum stalk length was recorded in 2020/CAUMHYB-1 (12.09 cm) while Lowest value was recorded for genotype 2019/CAUMHYB-5 (10.21 cm). The maximum days to maturity was recorded in 2019/CAUMHYB-6 (60.23) whereas minimum days to maturity was recorded in 2020/CAUMHYB-2 (51.10). The maximum curd length was noted in 2020/CAUMHYB-2 (7.03 cm) whereas the minimum curd width was noted in 2019/CAUMHYB-5 (5.97 cm). The maximum width of curd was noted in 2020/CAUMHYB-6 (15.67 cm) whereas the minimum width of curd was noted in 2019/CAUMHYB-6 (13.39 cm).

The maximum curd depth was recorded 9.93 cm in 2020/CAUMHYB-4, whereas the minimum curd depth recorded is 8.37 cm in 2019/CAUMHYB-5. The highest number of leaves attached to curd was noted in 2020/CAUMHYB-1 (7.20), whereas the lowest was noted in 2019/ CAUMHYB-5 (5.93). Maximum gross plant weight was recorded for genotype 2020/CAUMHYB-2 (1426.00 g), while genotype 2019/CAUMHYB-2 (1168 g) recorded lowest gross plant weight. The maximum marketable curd weight was observed in 2020/CAUMHYB-1 (372.67 g), whereas the minimum marketable curd weight was observed in 2019/ CAUMHYB-3 (307.87 g).

The maximum marketable curd yield was observed in 2020/CAUMHYB-1 (16.90 kg), whereas the least marketable curd weight was observed in 2019/CAUMHYB-2 (11.53 kg). The genotype which recorded shortest crop duration was 2020/CAUMHYB-3 (99.87 days).

GCV and PCV were recorded for plant height (11.15 and 14.17 percent), number of leaves (6.82 and 10.06 percent), leaf length (6.33 and 8.89 percent), leaf width (7.48 and 13.26 percent), stalk length (5.63 and 7.62 percent), days to curd maturity from DAT (3.66 and 6.71 percent), curd length (4.52 and 7.83 percent), curd width (3.82 and 6.78 percent), curd depth (4.07 and 7.38 percent) and number of leaves attached to the curd (3.96 and 13.00 percent), gross weight of the plant (6.53 and 8.74 percent), marketable yield per plant (4.49 and 7.85 percent), marketable yield per plot (7.48 and 13.00 percent), duration of crop (from sowing to last harvest) in days (3.39 and 6.21 percent) suggested existence of considerable variability in the population. Selection for these traits may also be given the importance for improvement programme.

The genotypic correlation for curd yield and its component in cauliflower are presented in Table 2. Correlation analysis revealed that Curd yield per plant (g) showed highly significant positive correlation with plant height (rg = 1.137 and rg = 0.505), number of leaves (rg = 1.035 and rp = 0.404), leaf width (rg = 0.445 and rp = 0.349), stalk length (rg = 1.185 and rp = 0.479), days to curd maturity (rg= 0.452 and rp= 0.352), gross weight of the plant (rg= 1.129 and rp= 0.446).

Curd yield per plot (kg) showed highly significant and positive correlation with number of leaves (rg = 0.812 and rp = 0.507), leaf length (rg = 0.462 and rp = 0.532), days to curd maturity (rg = 0.896 and rp = 0.588), curd length (rg = 0.827 and rp = 0.387), number of leaves attached to the curd (rg = 0.751 and rp = 0.382), Gross weight of the plant (rg = 0.939 and rp = 0.370), marketable yield per plant (rg = 0.993 and rp = 0.514).

Gross weight of the plant (g) had significant positive correlation with plant height (rg = 0.961 and rp = 0.683), leaf length (rg = 0.835 and rp = 0.461), leaf width (rg = 0.651 and rp = 0.351), stalk length (rg = 1.003 and rp = 0.573), curd width (rg = 0.760 and rp = 0.486), curd depth (rg = 0.185 and rp = 0.354), number of leaves attached to the curd (rg = 0.708 and rp = 0.544).

Curd width showed highly significant positive correlation with plant height (rg = 0.846 and rp = 0.545), leaf width (rg = 1.227 and rp = 0.477), stalk length (rg = 0.788 and rp = 0.467).

Curd length had positively and significantly correlated with plant height (rg = 1.014 and rp = 0.341) and number of leaves (rg = 0.936), leaf length (rg = 0.497), stalk length (rg = 0.623) at genotypic level only.

Leaf width had positive significant correlation with plant height (rg = 0.632 and rp = 0.469), leaf length (rg = 0.925 and rp = 0.760). Leaf length showed significant positive correlation with plant height (rg = 0.820 and rp = 0.609).

These results are in accordance with earlier researchers Dhiman *et al*. (1983) [3] and Kumar *et al*. (2004) [4].

Table 1: Mean performance for curd yield and its component characters

Genotypes	Characters													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
2020/CAUMHYB-1	45.47	21.90	27.73	17.15	12.09	58.80	7.00	14.77	9.87	7.20	1422	372.67	16.90	106.80
2020/CAUMHYB-2	50.73	19.37	26.95	15.36	11.75	55.07	7.03	15.18	8.99	6.87	1426	349.20	15.10	101.73

2020/CAUMHYB-3	42.83	19.90	25.45	16.08	11.87	53.20	6.13	13.72	9.32	6.53	1374	327.20	15.07	99.87
2020/CAUMHYB-4	44.35	18.37	28.21	19.03	11.61	54.57	6.06	15.33	9.93	7.13	1375	336.00	14.17	100.70
2020/CAUMHYB-5	45.25	17.57	28.33	17.87	11.87	56.27	6.27	15.30	8.91	6.87	1412	335.90	13.77	110.00
2020/CAUMHYB-6	42.85	18.80	27.43	18.13	11.57	52.90	6.67	15.67	8.62	6.93	1384	322.80	14.50	104.67
2019/CAUMHYB-1	37.65	19.00	26.07	15.85	10.65	51.90	5.97	14.05	8.87	6.47	1221	310.33	12.70	114.00
2019/CAUMHYB-2	37.71	18.10	24.70	16.76	10.84	51.10	6.43	14.80	8.60	6.47	1168	318.73	11.53	101.93
2019/CAUMHYB-3	36.89	17.93	24.54	15.27	10.56	53.97	6.22	14.07	9.27	6.47	1240	307.87	13.23	100.00
2019/CAUMHYB-4	36.94	15.53	27.39	15.96	10.30	55.43	6.07	14.05	9.55	6.60	1287	310.87	13.77	109.47
2019/CAUMHYB-5	34.87	18.33	22.96	13.93	10.21	53.47	5.97	14.18	8.37	5.93	1318	320.47	13.63	110.33
2019/CAUMHYB-6	35.34	18.90	23.13	13.88	10.39	60.23	6.36	13.39	9.13	6.47	1170	312.00	15.03	108.00
MEAN	40.91	18.64	26.08	16.27	11.14	54.74	6.35	14.54	9.12	6.66	1316	327.00	14.12	105.63
S.Em (±)	2.07	0.80	0.94	1.03	0.33	1.78	0.23	0.47	0.32	0.23	44	12.17	0.87	3.17
CD(P=0.05)	6.06	2.33	2.76	3.02	0.97	5.22	0.69	1.38	0.95	0.69	129	35.69	2.54	9.29
CV (%)	8.74	7.40	6.24	10.95	5.13	5.63	6.40	5.60	6.15	6.11	5.80	6.45	10.64	5.20

1- Plant height 4-Leaf width 7- curd length 9- curd depth 12- Marketable yield per plant
2- No. of leaves/plant 5- Stalk length 8- curd width 10- no. of leaves attached to the curd 13- Marketable yield per plot
3-Leaf length 6- Days to curd maturity 11- Gross weight of the plant 14- crop duration

Table 2: Genotypic association analysis among curd yield and its component characters

Sl. No.	Characters	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Plant height (cm)													
2	Number of leaves	0.663**												
3	Leaf length (cm)	0.820**	-0.000											
4	Leaf Width (cm)	0.632**	0.050	0.925**										
5	Stalk length (cm)	0.920**	0.878**	0.725**	0.807**									
6	Days to marketable curd maturity	0.149	0.365**	0.024	-0.601**	0.097								
7	Curd Length (cm)	1.014**	0.936**	0.497**	0.274	0.943**	0.623**							
8	Curd Width (cm)	0.846**	0.107	1.005**	1.227**	0.788**	-0.130	1.059**						
9	Curd Depth (cm)	0.406**	0.394*	0.755**	0.764**	0.490**	1.158**	0.074	-0.331*					
10	Number of leaves attached to the curd	0.957**	0.748**	1.292**	1.232**	1.101**	0.650**	0.859**	0.939**	0.715**				
11	Gross weight of the plant (g)	0.961**	0.428**	0.835**	0.651**	1.003**	0.344*	0.684**	0.760**	0.185	0.708**			
12	Marketable Yield / plant (g)	1.137**	1.035**	0.870**	0.445**	1.185**	0.452**	1.361**	0.954**	0.941**	1.301**	1.129**		
13	Marketable curd yield / plot (kg)	0.799**	0.812**	0.462**	0.063	0.918**	0.896**	0.827**	0.292	0.917**	0.751**	0.939**	0.993**	
14	Crop duration	-0.663**	-0.133	-0.046	-0.554**	-0.652**	-0.133	-0.330*	-0.317	-0.305	-0.655**	-0.401**	-0.354**	-0.139

Conclusion

In nutshell, based on present investigation, it can be concluded that genotype 2020/CAUMHYB1 was found to be suitable over other genotype and can be grown successfully in Chhattisgarh plains.

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