International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 4757-4761

Received: 21-03-2019
Accepted: 25-04-2019

Basavaraj
PhD Scholar, Department of Vegetable Science, KRC College of Horticulture, Arabhavi, Karnataka, India

CN Hanchinamani
Professor and Head, Department of Vegetable Science, KRC College of Horticulture, Arabhavi, Karnataka, India

Imamsaheb SJ
Assistant professor, Department of Vegetable Science, College of Horticulture, Bidar, Karnataka, India

Chethan Kumar S
PhD Scholar, Department of Vegetable Science, KRC College of Horticulture, Arabhavi, Karnataka, India

Dhanraj P
PhD Scholar, Department of Plantation, Spices, Medicinal and Aromatic Crops, KRC College of Horticulture, Arabhavi, Karnataka, India

Chandrakant Kamble
Assistant professor, Department of Vegetable Science, HRES, Hidakal Dam, Belagavi, Karnataka, India

Correspondence
Basavaraj
PhD Scholar, Department of Vegetable Science, KRC College of Horticulture, Arabhavi, Karnataka, India

Character association and path analysis studies in bathua (*Chenopodium album* L.)

Basavaraj, CN Hanchinamani, Imamsaheb SJ, Chethan Kumar S, Dhanraj P and Chandrakant Kamble

Abstract
Correlation and path coefficient were studied in 24 bathua (*Chenopodium album* L.) genotypes for 21 characters to find out the inter relationship among the characters studied. Foliage yield/plant was found highly significant and positively correlated with plant height, number of leaves/plant, number of branches/plant, leaf area, stem girth, fresh and dry weight of plant, foliage yield/plot, foliage yield/hectare which indicated that yield could be increased by improving a traits. The path coefficient analysis splits total correlation coefficient of different characters in to direct effect and indirect effect in equal to phenotypic correlation. The data revealed that foliage yield per plot (0.133) showed the highest positive direct effect on foliage yield/plant followed by nitrates content (-0.335) showed negative direct effects. The characters showed high direct effect on yield/plant indicated that direct selection for these traits might be effective and there is a possibility of improving yield/plant through selection based on these characters.

Keywords: Bathua, correlation, path analysis, selection, characterization

1. Introduction
Bathua (2n=36) belonging the family chenopodiaceous is an important underexploited leafy vegetable crop of the world, originating from the Europe, and has attracted attention to the world food supply. It is a plant that stands out for its good nutritional value. The edible parts involve leaves, stem and grains, the latter being the most economically and scientifically explored (Rock, 2008).The degree of association between characters as indicated by the correlation coefficients has always been a helpful instrument for the selection of desirable characters under a breeding program. Like other crops, yield of bathua is the final product attributed by a complex chain of interrelating effects of different characters (Islam and Khan, 2010) [4]. So, it is essential to make a comparative study among important characters to select desirable ones. Correlation coefficient alone cannot give a complete picture of the causal basis of relationship. Under such circumstances, path coefficient analysis is an effective tool (Islam and Khan, 2010 and Mc Giffen *et al*., 1994) [4, 7]. Therefore, present investigation was undertaken to estimate association among desired traits and their direct and indirect contributions toward yield.
However, yield is a complex character; its direct is difficult. Knowledge in respect of the nature and magnitude of associations of yield with various component characters is a pre-requisite to bring improvement in the desired direction. A crop breeding programme, aimed at increasing the plant productivity requires consideration not only of yield but also of its components that have a direct or indirect bearing on yield. Path coefficient analysis measures the direct influence of one variable upon another and permits the separation of correlation coefficient into components of direct and indirect effects.

2. Material and Methods
The present investigations were conducted during *Kharif* 2017 at Vegetable Science Department Farm, Kittur Rani Channamma College of Horticulture, Arabhavi (Karnataka). The experiment was laid out in Randomized Block Design with three replications. The study comprises 24 bathua genotypes namely EC-359444, NC-50229, IC-341703, EC-359445, IC-243192, IC-109249, NIC-22506, NC-58616, NIC-22492, IC-109235, IC-415477, IC-540831, NIC-22517, IC-540842, IC-4152393, HUB – 1, HUB – 2, HUB – 3, HUB – 4, HUB – 5,

HUB-6, HUB-7, HUB-8, HUB-9. The soil of experimental farm was loam with normal ph. Suitable agronomic and cultural practices were adopted to obtain good phenotypic expression of the characters. The data were recorded for 21 characters. The technique of path coefficient analysis developed by Wright (1921) [9] and demonstrated by Dewey and Lu (1959) [3] facilitates the partitioning of correlation coefficients into direct and indirect contribution of various characters on yield.

Table 1: Phenotypic correlation coefficients among growth, yield and quality parameters in bathua

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	1	0.444**	0.389**	0.224	0.122	0.314**	0.336**	0.445**	0.501**	0.325**	0.338**	0.437**	0.409**	0.400**	0.545**	0.336**	0.506**	0.424**	-0.345**	-0.474**	-0.298**	0.588**
2		1	0.435**	0.587**	0.021	0.026	0.052	0.384**	0.414**	0.384**	0.445**	0.302**	0.473**	0.402**	0.476**	0.376**	0.483**	0.402**	-0.333**	-0.461**	-0.257**	0.589**
3			1	0.374**	0.083	0.169	0.163	0.341**	0.366**	0.320**	0.388**	0.138	0.293*	0.347**	0.433**	0.275*	0.443**	0.376**	-0.292**	-0.282**	-0.252**	0.478**
4				1	-0.12	-0.021	-0.05	0.458**	0.534**	0.385**	0.411**	0.229	0.468**	0.508**	0.385**	0.530**	0.385**	0.341**	-0.166	-0.362**	-0.426**	0.588**
5					1	0.305**	0.352**	0.137	-0.04	0.085	0.074	0.06	0.254*	-0.049	0.055	-0.05	0.201	0.013	-0.214	-0.17	-0.16	0.081
6						1	0.531**	0.043	0.093	0.066	0.156	-0.101	0.267*	0.053	0.185	-0.163	0.292*	0.205	-0.316**	-0.084	-0.053	0.13
7							1	0.059	0.022	-0.01	0.058	-0.105	0.13	0.099	-0.015	-0.163	0.094	-0.05	-0.08	-0.093	-0.022	-0.026
8								1	0.831**	0.561**	0.503**	0.541**	0.540**	0.264*	0.565**	0.686**	0.498**	0.312**	-0.498**	-0.564**	-0.329**	0.667**
9									1	0.494**	0.494**	0.412**	0.509**	0.312**	0.508**	0.573**	0.528**	0.331**	-0.501**	-0.512**	-0.337**	0.665**
10										1	0.925**	0.477**	0.468**	0.330**	0.362**	0.599**	0.386**	0.382**	-0.417**	-0.544**	-0.391**	0.636**
11											1	0.423**	0.444**	0.361**	0.385**	0.541**	0.453**	0.463**	-0.416**	-0.571**	-0.419**	0.652**
12												1	0.376**	0.225	0.429**	0.521**	0.284**	0.348**	-0.258**	-0.420**	-0.387**	0.592**
13													1	0.339**	0.539**	0.428**	0.464**	0394**	-0.387**	-0.427**	-0.381**	0.555**
14														1	0.479**	0.538**	0.376**	0.394**	0.049	-0.393**	-0.369**	0.533**
15															1	0.494**	0.580**	0.505**	-0.380**	-0.323**	-0.363**	0.614**
16																1	0.463**	0.385**	-0.17	-0.627**	-0.380**	0.728**
17																	1	0.513**	-0.237**	-0.503**	-0.118	0.618**
18																		1	-0.267**	-0.272**	-0.336**	0.605**
19																			1	0.246**	0.349**	-0.423**
20																				1	0.328**	-0.738**
21																					1	-0.537**
22																						1

Critical r $_g$ value at 5%= 0.2318, Critical r $_g$ value at 1% = 0.3017, *significant at 5% **Significant at 1%

1. Plant height 8. Fresh weight of plant 15. Calcium
2. Number of leaves per plant 9. Dry weight of plant 16. Magnesium
3. Number of branches per plant 10. Foliage yield per plot 17.Iron
4. Leaf area 11.foliage yield per hectare 18. Zinc
5. Stem girth 12. Vitamin-A 19.Oxalates
6. Plant spread E- W 13. Vitamin-C 20. Nitrates
7. Plant spread N-S 14. Protein 21.Total phenol 22. Foliage yield per plant

Table 2: Phenotypic path coefficient analysis for yield and its components in bathua

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	R G
1	0.041	0.018	0.016	0.009	0.005	0.013	0.013	0.018	0.020	0.013	0.014	0.018	0.017	0.016	0.022	0.013	0.021	0.017	-0.014	-0.019	-0.012	0.588**
2	0.020	0.046	0.020	0.027	0.001	0.001	0.002	0.017	0.019	0.017	0.020	0.014	0.022	0.018	0.022	0.017	0.022	0.018	-0.015	-0.021	-0.012	0.589**
3	0.031	0.035	0.081	0.030	0.006	0.013	0.013	0.027	0.029	0.026	0.031	0.011	0.024	0.028	0.035	0.022	0.036	0.030	-0.023	-0.023	-0.020	0.478**
4	0.027	0.072	0.046	0.124	-0.015	-0.002	-0.006	0.056	0.066	0.047	0.051	0.028	0.058	0.063	0.047	0.065	0.047	0.042	-0.020	-0.045	-0.052	0.588**
5	0.001	0.001	0.001	-0.001	0.009	0.002	0.003	0.001	-0.001	0.001	0.001	0.001	0.002	-0.001	0.001	-0.001	0.002	0.001	-0.002	-0.001	-0.001	0.081
6	0.026	0.002	0.014	-0.001	0.025	0.084	0.044	0.003	0.007	0.005	0.013	-0.008	0.022	0.004	0.015	-0.013	0.024	0.017	-0.026	-0.007	-0.004	0.130
7	-0.025	-0.004	-0.012	0.003	-0.026	-0.040	-0.075	-0.004	-0.001	0.001	-0.004	0.008	-0.009	-0.007	0.001	0.012	-0.007	0.003	0.006	0.007	0.001	-0.026
8	-0.036	-0.031	-0.027	-0.037	-0.011	-0.003	-0.004	-0.081	-0.067	-0.045	-0.041	-0.044	-0.043	-0.021	-0.046	-0.055	-0.040	-0.025	0.040	0.045	0.026	0.667**
9	0.055	0.046	0.040	0.059	-0.004	0.010	0.002	0.092	0.111	0.055	0.055	0.045	0.056	0.034	0.056	0.064	0.058	0.036	-0.055	-0.057	-0.037	0.665**
10	0.043	0.051	0.042	0.051	0.011	0.008	-0.001	0.075	0.066	0.133	0.123	0.063	0.062	0.044	0.048	0.080	0.051	0.051	-0.055	-0.072	-0.052	0.636**
11	-0.043	-0.057	-0.049	-0.052	-0.009	-0.020	-0.007	-0.064	-0.063	-0.119	-0.128	-0.054	-0.057	-0.046	-0.049	-0.069	-0.058	-0.059	0.053	0.073	0.053	0.652**
12	0.066	0.046	0.021	0.035	0.009	-0.015	-0.016	0.082	0.063	0.073	0.064	0.152	0.057	0.034	0.065	0.079	0.043	0.053	-0.039	-0.064	-0.059	0.592**
13	-0.023	-0.027	-0.017	-0.027	-0.014	-0.015	-0.007	-0.031	-0.029	-0.027	-0.025	-0.021	-0.058	-0.019	-0.031	-0.025	-0.027	-0023	0.022	0.024	0.022	0.555**
14	0.011	0.011	0.009	0.014	-0.001	0.001	0.002	0.007	0.008	0.009	0.009	0.006	0.009	0.027	0.013	0.014	0.010	0.010	0.001	-0.010	-0.010	0.533**
15	0.026	0.023	0.020	0.018	0.002	0.008	-0.001+	0.027	0.024	0.017	0.018	0.020	0.026	0.023	0.048	0.023	0.028	0.024	-0.018	-0.015	-0.017	0.614**
16	0.048	0.054	0.040	0.076	-0.007	-0.023	-0.023	0.099	0.083	0.086	0.078	0.075	0.062	0.078	0.071	0.014	0.067	0.055	-0.047	-0.090	-0.055	0.728**
17	0.024	0.022	0.021	0.018	0.009	0.013	0.004	0.023	0.025	0.018	0.021	0.013	0.022	0.017	0.027	0.022	0.047	0.024	-0.011	-0.023	-0.005	0.618**
18	0.076	0.072	0.068	0.061	0.002	0.037	-0.009	0.056	0.059	0.068	0.083	0.062	0.071	0.071	0.091	0.069	0.092	0.018	-0.048	-0.049	-0.060	0.605**
19	0.024	0.023	0.020	0.011	0.015	0.022	0.005	0.035	0.035	0.029	0.029	0.018	0.027	-0.003	0.027	0.012	0.016	0.019	-0.071	-0.017	-0.024	-0.423**
20	0.158	0.154	0.094	0.121	0.057	0.028	0.031	0.189	0.171	0.182	0.191	0.141	0.143	0.131	0.108	0.210	0.168	0.091	-0.082	-0.335	-0.110	-0.738**
21	0.031	0.026	0.026	0.044	0.016	0.005	0.002	0.034	0.035	0.041	0.043	0.040	0.039	0.038	0.038	0.039	0.012	0.035	-0.036	-0.034	-0.104	-0.537**

Diagonal indicates direct effect *Significant at 5% **Significant at 1% r G- Genotypic correlation with foliage yield per plant
Residual effect = 0.0644

1. Plant height 8. Fresh weight of plant 15. Calcium
2. Number of leaves per plant 9. Dry weight of plant 16. Magnesium
3. Number of branches per plant 10. Foliage yield per plot 17. Iron
4. Leaf area 11.foliage yield per hectare 18. Zinc
5. Stem girth 12. Vitamin-A 19.Oxalates
6. Plant spread E- W 13. Vitamin-C 20. Nitrates
7. Plant spread N-S 14. Protein 21. Total phenol 22. Foliage yield per plant

phenol 22. Foliage yield per plant

3. Result and Discussion

The correlation coefficient would indicate only the relationship of independent variables with the dependent variable without specifying cause and effect. Using path coefficient analysis, it is possible to resolve the correlations, by subjecting the correlation co-efficient to path analysis for partitioning the correlation values into direct and indirect effect through alternate ways. In general, the results revealed the genotypic correlation co-efficient were higher than the phenotypic correlation co-efficient for the characte999r

studied. The results obtained from the phenotypic correlation co-efficient are presented in Table 1. The results showing the direct and indirect effect of various traits on leaf yield per plant are presented in Table 2.

In the present study, foliage yield per plant was significantly and positively correlated with plant height, number of leaves per plant, number of branches per plant, leaf area, stem girth, fresh weight of plant and dry weight of plant content at phenotypic level. Similar observations were made by Sarker *et al*. (2014) [8], Khurana *et al*. (2013) [5], Ahmmed *et al*. (2012) [1] for plant height; Sarker *et al*. (2014) [8],

At phenotypic level, plant height had found significant (both at p=0.01 and p=0.05) and positive correlation with number of leaves per plant, number of branches per plant, plant spread E-W, plant spread N-S, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A, vitamin-C, protein, calcium, magnesium, iron, zinc content. It was also positively correlated with foliage yield per plant. It was also positively but non-significantly correlated with leaf area, stem girth.

Number of leaves per plant showed positive and significant (at both p=0.01 and p=0.05) correlation with number of branches per plant, leaf area, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A, vitamin-C, protein, calcium, magnesium, iron and zinc content. It was also positively correlated with foliage yield per plant. It was also positively but non-significantly correlated with stem girth, plant spread E-W, plant spread N-S.

Number of branches per plant shows positive and significant (at both p=0.01 and p=0.05) correlation with leaf area, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, protein, calcium, iron, zinc. It was also positively correlated with foliage yield per plant. It was also positively but non-significantly correlated with stem girth, plant spread E-W, plant spread N-S, vitamin-A content.

Positive and significant (both at p=0.01 and p=0.05) association was found for leaf area with fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-C, protein, calcium, magnesium, iron, zinc content and foliage yield per plant. It was also positively but non-significantly correlated with vitamin-A content.

Fresh weight of plant shows positive and significant (at both p=0.01 and p=0.05) correlation with dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A, vitamin-C, calcium, magnesium, iron and zinc content. It was also positively correlated with foliage yield per plant.

Positive and significant (both at p=0.01 and p=0.05) association was found for vitamin-A with vitamin-C, calcium, magnesium, and zinc content. It was also positively correlated with foliage yield per plant. It was also positively but non-significantly correlated with protein content.

Positive and significant (both at p=0.01 and p=0.05) association was found for vitamin-C with protein, calcium, magnesium, iron and zinc content. It was also positively correlated with foliage yield per plant.

Positive and significant (both at p=0.01 and p=0.05) association was found for protein with calcium, magnesium, iron and zinc content. It was also positively correlated with foliage yield per plant.

3.1 Phenotypic path co-efficient for yield

3.1.a Direct effect on foliage yield per plant

Whereas at phenotypic level foliage yield per plot had positive direct effect on yield followed by leaf area, dry weight of plant, vitamin-A content, plant height, number of leaves per plant, number of branches per plant, stem girth, plant spread E-W, protein content, calcium content, magnesium content, iron content, zinc content but plant spread N-S, fresh weight of plant, foliage yield per hectare, vitamin-C content, oxalates content, nitrates content and total phenol content had negative direct effect on yield, indicating that if other factors are held constant, on increase in their characters individually will reflects in the increased yield. Similar observations were reported by Khurana *et al.* (2013) [5] for number of leaves per plant, leaf area, protein content Yogendra *et al*. (2015) [10] for number of branches per plant; Sarker *et al*. (2014) [8], Anuja *et al.* (2012) [2], Kujur *et al*. (2015) [6], for number of leaves per plant in their experiments.

3.1. b. Indirect effect on foliage yield per plant

Plant height had found positive indirect effect through number of leaves per plant, number of branches per plant, leaf area, stem girth, plant spread E-W, plant spread, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A content, vitamin-C content, protein content, calcium content, magnesium content, iron content, zinc content.

Number of leaves per plant had found positive indirect effect through number of branches per plant, plant height, leaf area, stem girth, plant spread N-S, plant spread E-W, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A content, vitamin-C content, protein content, calcium content, magnesium content, iron content, zinc content.

Number of branches per plant had found positive indirect effect through plant height, number of leaves per plant, leaf area, stem girth, plant spread E-W, plant spread N-S, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare.

Leaf area had found positive indirect effect through plant height, number of leaves per plant, number of branches per plant, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A content, vitamin-C content.

Stem girth had found positive indirect effect through plant height, number of leaves per plant, number of branches per plant, plant spread E-W, plant spread N-S, fresh weight of plant, foliage yield per plot, foliage yield per hectare.

Foliage yield per hectare had found positive indirect effect through oxalate content, nitrate content, total phenol content.

Vitamin-A content had found positive indirect effect through plant height, number of leaves per plant, number of branches per plant, leaf area, stem girth, fresh weight of plant, dry weight of plant, and foliage yield per plot, foliage yield per hectare, vitamin-C content, protein content, calcium content, magnesium content, iron content, zinc content.

Vitamin-C had found positive indirect effect through oxalate content, nitrate content, total phenol content. Protein content had found positive indirect effect through plant height, number of leaves per plant, number of branches per plant, leaf area, plant spread E-W, plant spread N-S, fresh weight of plant, dry weight of plant, foliage yield per plot, foliage yield per hectare, vitamin-A content, vitamin-C content, calcium content, magnesium content, iron content, zinc content, oxalate content.

4. References

1. Ahammed AU, Rahman MM, Mian MAK. Genetic variability, heritability and correlation in stem

amaranthus *Amaranthus tricolor* L. Bangladesh J. Pl. Breed. Genet. 2012; 25(2):25-32.
2. Anuja, S. Correlation and path coefficient analysis in amaranthus. *Crop Res*. 2012; 43(1):106-111.
3. Dewey OR, Lu KH. A correlation and path coefficient analysis of components of crested wheatgrass seed production. J. Agron. 1959; 57:515-518.
4. Islam BMR, Ivy NA, Rasul MG, Zakari M. Character association and path analysis of exotic tomato *Solanum lycopersicum* L. genotypes. Bangladesh J. Pt. Breeding Gen. 2010; 23(1):13-18.
5. Khurana DS, Sing J, Kaur B. Genetic variability, correlation and path coefficient analysis in Amaranthus. Vegetable Science. 2013; 40(2):238-240.
6. Kujur A. Collection, Evaluation and identification of suitable genotypes of khedha *Amaranthus dubius* Mart. under Chhattisgarh plain condition. M. Sc. Agri. Thesis, Indira Gandhi Krishi Vishwavidyala, Raipur Chhattisgarh, 2015.
7. McGiffen ME, Pantone DJ, Masiunas JB. Path analysis of tomato yield components in relation to competition with black and eastern black nightshade. J. of American soci. Hort. Sci. 1994; 119:6-11.
8. Sarker U, Islam T, Rabbani G, Oba S. Genotypic variability for nutrient, antioxidant, yield and yield contributing traits in vegetable amaranthus. Journal of Food, Agriculture and Environment. 2014; 12(3):168-174.
9. Wight S. Correlation and Causation. J. Agri. Res. 1921; 20:202-209.
10. Yogendra Kumar. Collection, evaluation and identification of suitable genotypes of amaranthus *Amaranthus* spp. for chhatisgarh plain condition. M. Sc. Thesis, Indira Gandhi Krishi Vishwavidyalaya, Raipur, 2015.