Research Article

Correlation and Path Coefficient Analysis in Ash Gourd [*Benincasa Hispida* (Thunb) Cogn.] for Yield and Yield Attributing Traits

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Abstract

Six parents of ash gourd (*Benincasa hispida*) were selected based on their performance and were crossed in a diallel mating system to generate 30 F_1 hybrids. These hybrids along with the parents were grown to study association of characters in 15 yield related characters. Correlation coefficient indicated that yield per vine had highly significant and positive association with the individual fruit weight(0.840), number of fruits per vine (0.674), fruit length (0.522), fruit girth (0.507) and flesh thickness (0.395). Path analysis revealed that the fruit characters such as flesh thickness, fruit length, fruit weight, fruit girth and number of fruits per vine are considered as important traits which directly and indirectly influences towards yield. This study confirm that, individual fruit weight, number of fruit per plant, fruit length, fruit girth and flesh thickness were the important characters for varietal selection of ash gourd.

Keywords: Ash gourd, Correlation coefficient, Direct and Indirect effects, Yield per vine

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Introduction

Ash gourd **[***Benincasa hispida* (Thunb.) Cogn.] is an important sub-tropical and tropical cucurbitaceous vegetable which is extensively grown in India for its nutritional, medicinal as well as curative properties. The fruits are consumed in various ways, as fresh vegetables, candied, dried, pickled, and also used in ayurvedic medicine preparation. Ash gourd is considered good for people suffering from nervousness and debility [1]. It has also great demand in processing industries for preparation of various products, the juice of ripe fruit is used for curing insanity and epilepsy [2], urinary infection and biliousness [3], possesses anti-ulcer activity [4] and as a tonic for heart [3]. It is candied with sugar and used to prepare a popular sweet called 'petha'.

Ash gourd is much priced for its medicinal properties, but comparatively little attention had been paid for the improvement of this crop. One disadvantage of this crop is its trailing habit and big sized fruit which makes the plant rather difficult to handle. Besides, due to this growth habit, the plant occupies considerably larger area thus makesit less profitable than many other cucurbitaceous vegetables. Naturally, therefore, any improvement of this crop should aim at producing more compact plant with sturdy fruits.

There are many hybrids and varieties of ash gourd having different traits prevailing in India, especially southern parts of India. A study of correlation between yield and its components and their relative contribution to the yield have a great importance in planning effective breeding programmes and selection of hybrids and parents. Path coefficient analysis is also an important tool for the better understanding of the crop inheritance in respect of yield. It gives specific measures on the direct and indirect effect of each component character on yield. Considering the above factors, the present study was undertaken to improve fruit yield of ash gourd using correlation and path analysis of yield and yield contributing characters of 30 hybrids and 6 parents of ash gourd.

Materials and Methods

Six genotypes of ash gourd, *viz.,* KAU local, CO_2, Ottanchathiram local, Vasundhara, Karaikal local and Indu were used as parents for crossing programme in all possible combinations adopting full diallel mating design. In *kharif* 2011 the performance of the parents and 30 F1 hybrids was assessed in a randomized block design with three replications in the precession farming field of PAJANCOA & RI, Karaikal. Seeds were sown on pro trays and transplanted 20 days after sowing, with keeping a distance of 2 m between beds and 1.5 m between plants. Drip irrigation was followed. Recommended agronomic practices were followed throughout the growing season to raise a healthy crop. Vine length, number of primary branches, days to first male flower anthesis, days to first female flower

anthesis, node at which first male flower anthesis, node at which first female flower anthesis, number of male flowers per plant, number of female flowers per plant, sex ratio, number of fruits per vine, fruit length, fruit girth, Individual fruit weight, flesh thickness and yield per vine were recorded. Correlation and path analysis for all the traits were analyzed using computer software Genres.

Results and Discussion

Selection of plants based on yield alone is not always completely reliable in a breeding programme. Yield is a complex entity governed by a number of other components. The association studies are useful in crops such as ash gourd when selection has to be exercised simultaneously for more than one character. The genotypic correlation coefficients between yield and its components and inter correlations among different yield attributes were estimated and presented in **Table 1**.

Correlation between fruit yield per vine and other traits

Individual fruit weight (0.840), number of fruits per vine (0.674), fruit length (0.522), fruit girth (0.507) and Flesh thickness (0.395) showed significant positive association with fruit yield per vine, while vine length (0.081), number of primary branches (0.171), node at which first female flower anthesis (0.052), number of male flowers per vine (0.246), number of female flowers per vine (0.219) and sex ratio (0.035) showed positive non-significant association with fruit yield per vine. Days to first male flower anthesis (-0.402) and days to first female flower anthesis (-0.584) showed negative and significant association with fruit yield per vine whereas node at which first male flower anthesis showed negative and non-significant association with fruit yield per vine. In this investigation individual fruit weight, number of fruits per vine, fruit length, fruit girth and flesh thickness had positively significant influence on yield per vine. But at the same time, significantly negative correlation with yield was registered for days to first male flower anthesis and days to first female flower anthesis. Similar findings were reported by Parvathi and Nagabhushana Reddy, 2006 [5] in bottle gourd, Husna *et al.,* 2011 [6] in bottle gourd, Kumar *et al*., 2012 [2] in bottle gourd and Nagaraju *et al*., 2016 [4] in Ash gourd.

Inter correlation among different traits

Doku (1970) [7] suggested that intercorrelation among the yield components need to be estimated because one component influences the other related components.

Vine length showed significant positive correlation with number of fruits per vine and it was non-significant positive correlation with node at which first male flower anthesis, node at which first female flower anthesis, number of male flowers per vine, number of female flowers per vine, sex ratio, fruit girth, fruit length and individual fruit weight, whereas it registered non-significant negative association with number of number of primary branches, days to first male flower anthesis, days to first female flower anthesis and flesh thickness with yield per vine. Similar findings were reported Karuppiah *et al*., 2005 [8] in ridge gourd, Latif *et al.*, 2008 [9] in ash gourd, Kothainayagi, 2013 [10] in pumpkin and Nagaraju *et al*., 2016 [4] in ash gourd.

The trait, number of primary branches exhibited positive and significant correlation with flesh thickness (0.953), Fruit length (0.362) and fruits girth (0.334). It showed non-significant positive correlation with days to first male flower anthesis, days to first female flower anthesis, node at which first male flower anthesis, number of male flowers per vine, sex ratio, number of fruits per vine and individual fruit weight whereas node at which first female flower anthesis and number of female flowers per vine were negatively correlated with yield per vine.Similar findings were reported Resmi and Sreelathakumary, 2012 [1] in Ash gourd and Kumar *et al.,* 2012 [2] in Bottle gourd.

The significant positive indirect association in the trait was found in days to first female flower anthesis (0.621) whereas significant negative association with number of female flowers per vine (-0.478) and number of fruits per vine (-0.802). It had positively non-significant indirect association with node at which first male flower anthesis, sex ratio, fruit girth and flesh thickness whereas negatively non-significant with node at which first female flower anthesis, number of male flowers per vine, fruit length and individual fruit weight. The days to first female flower anthesis was significant and negatively correlated with number of fruits per vine (-0.656), fruit length (0.443) and individual fruit weight (0.450). It had non-significant and positively correlated with sex ratio, while non-significant and negatively correlated with node at which first male flower anthesis, node at which first female flower anthesis, number of male flowers per vine, number of female flowers per vine, fruit girth and flesh thickness. This is in accordance with the respect of Kalaiselvan (2006) [11], Latif *et al.,* 2008 [9] in ash gourd and Kothainayagi (2013) [10] in pumpkin.

Table 1 Genotypic correlation co-efficients between yield and yield attributes

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000	-0.124	-0.229	-0.222	0.045	0.212	0.277	0.134	0.107	0.334*	0.144	0.225	0.115	-0.107	0.081
2		1.000	0.031	0.004	0.075	-0.067	0.042	-0.080	0.090	0.040	0.334*	0.362*	0.118	0.953**	0.171
3			1.000	0.621*	0.039	-0.055	-0.267	-0.478**	0.258	-0.794**	0.128	-0.028	-0.057	0.011	-0.402**
4				1.000	-0.083	-0.141	-0.182	-0.293	0.109	-0.656**	-0.172	-0.443**	-0.450**	-0.123	-0.584**
5					1.000	-0.491**	-0.001	0.020	0.008	-0.087	0.227	0.161	-0.123	0.039	-0.163
6						1.000	0.199	-0.358*	0.296	0.078	-0.315	-0.085	0.031	-0.066	0.052
7							1.000	-0.007	0.644**	0.108	0.170	0.317	0.303	0.048	0.246
8								1.000	-0.704**	0.451**	0.264	0.245	0.028	-0.075	0.219
9									1.000	-0.300	0.020	0.111	0.254	0.108	0.035
10										1.000	0.057	0.114	0.183	0.171	0.674**
11											1.000	0.824**	0.632**	0.430**	0.507**
12												1.000	0.680**	0.417*	0.522**
13													1.000	0.353*	0.840**
14														1.000	0.395*
15															1.000

**Significant at 1 per cent level; *Significant at 5 per cent level

1.Vine length; 2.Number of primary branches; 3.Days to first male flower anthesis; 4.Days to first female flower anthesis; 5.Node at which first male flower anthesis; 6.Node at which first female flower anthesis; 7.Number of male flowers per vine; 8.Number of female flowers per vine; 9.Sex ratio; 10.Number of fruits per vine; 11.Fruit girth; 12.Fruit length; 13.Individual fruit weight; 14.Flesh thickness; 15.Yield per plant

Node at which first male flower anthesis recorded negative and significant with node at which first female flower anthesis (-0.491). It also exhibited positive and non-significantly correlated with number of female flowers per vine, sex ratio, fruit girth, fruit length and flesh thickness whereas negative and non-significantly correlated with number of male flowers per vine, number of fruits per vine and individual fruit weight. The trait node at which first female flower anthesis registered significant and negatively correlated with number of female flowers per vine (-0.358). The trait exhibited positive and non-significantly associated with number of male flowers per vine, sex ratio, number of fruits per vine and individual fruit weight, while negative and non-significant with fruit girth, fruit length and flesh thickness. This is in accordance with Borthakur and Baruah (2006) [12].

Number of male flowers was significantly and positively association with sex ratio (0.644). It had positively non-significant with number of fruits per vine, fruit girth, fruit length, individual fruit weight and flesh thickness, while number of male flowers per vine was negatively non-significant with number of female flowers per vine. number of female flowers per vine was highly exhibited significant positive association with number of fruits per vine (0.451) whereas sex ratio (-0.704) exhibited negatively significant with number of female flowers per vine. It had exhibited positively non-significant with fruit girth, fruit length and individual fruit weight whereas flesh thickness exhibited negatively non-significant with yield per vine. This is in accordance with Borthakur and Baruah (2006) [12]. Sex ratio had positively non-significant with the traits *viz*., fruit girth, fruit length, individual fruit weight and flesh thickness while negatively non-significantly correlated with number of fruits per vine. The traits fruit girth, fruit length, individual fruit weight and flesh thickness registered positively non-significant with number of fruits per vine. Fruit girth had positively and significant with three traits *viz*., fruit length (0.824), individual fruit weight (0.632) and flesh thickness (0.430). The trait fruit length exhibited positively significant with individual fruit weight (0.680) and flesh thickness (0.417). Individual fruit weight was significant and positively correlated with flesh thickness (0.353). The association of number of fruits per plant with fruit weight was positive and not significant. This makes clear that increase in number of fruits per plant would indirectly affect the total yield.

Fruit girth was found to be significant and positive correlation with fruit length, individual fruit weight [13] and flesh thickness. Fruit length was found significant and positive for individual fruit weight and flesh thickness. Individual fruit weight was found to shown significant and positive correlation with yield. Therefore, fruit weight, number of fruits, fruit length, fruit girth and flesh thickness were considered as direct contributing characters towards yield. Whereas vine length, number of primary branches, number of female flowers and sex ratio were indirectly contributed to the yield through many of the fruit characters.

Path analysis

This is an efficient biometrical tool throwing light on the contribution (direct effect) through other component characters. The correlation coefficient were further partitioned into direct and indirect effects by path analysis and presented in **Table 2**.

Table 2 Path coefficient showing direct and indirect effects of different traits

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	**-0.1002**	0.8507	0.3107	-0.1209	-0.0136	0.0123	-0.0030	-0.0310	0.0027	-0.2483	-0.0171	0.3808	-0.1879	-0.7542	0.0810
2	0.0125	**-6.8471**	-0.0424	0.0023	-0.0225	-0.0039	-0.0005	0.0184	0.0023	-0.0297	-0.0397	0.6117	-0.1926	6.7023	0.1710
3	0.0230	-0.2144	**-1.3546**	0.3389	-0.0118	-0.0032	0.0029	0.1107	0.0066	0.5910	-0.0152	-0.0482	0.0936	0.0788	-0.4020*
4	0.0222	-0.0282	-0.8415	**0.5456**	0.0251	-0.0082	0.0020	0.0677	0.0028	0.4883	0.0205	-0.7497	0.7336	-0.8645	-0.5840**
5	-0.0045	-0.5122	-0.0530	-0.0455	**-0.3005**	-0.0285	0.0000	-0.0046	0.0002	0.0650	-0.0269	0.2718	0.2004	0.2756	-0.1630
6	-0.0212	0.4606	0.0742	-0.0767	0.1475	**0.0581**	-0.0022	0.0828	0.0075	-0.0578	0.0374	-0.1438	-0.0505	-0.4643	0.0520
7	-0.0278	-0.2863	0.3616	-0.0994	0.0003	0.0116	**-0.0108**	0.0017	0.0163	-0.0804	-0.0202	0.5366	-0.4942	0.3369	0.2460
8	-0.0134	0.5453	0.6478	-0.1596	-0.0060	-0.0208	0.0001	**-0.2315**	-0.0178	-0.3356	-0.0314	0.4137	-0.0457	-0.5262	0.2190
9	-0.0107	-0.6156	-0.3500	0.0594	-0.0024	0.0172	-0.0069	0.1629	**0.0253**	0.2232	-0.0024	0.1883	-0.4145	0.7617	0.0350
10	-0.0334	-0.2736	1.0754	-0.3578	0.0262	0.0045	-0.0012	-0.1044	-0.0076	**-0.7445**	-0.0068	0.1930	-0.2981	1.2023	0.6740**
11	-0.0145	-2.2892	-0.1736	-0.0941	-0.0681	-0.0183	-0.0018	-0.0612	0.0005	-0.0423	**-0.1188**	1.3936	-1.0301	3.0250	0.5070**
12	-0.0226	-2.4762	0.0386	-0.2418	-0.0483	-0.0049	-0.0034	-0.0566	0.0028	-0.0850	-0.0979	**1.6913**	-1.1077	2.9340	0.5220**
13	-0.0116	-0.8090	0.0778	-0.2456	0.0370	0.0018	-0.0033	-0.0065	0.0065	-0.1362	-0.0751	1.1495	**-1.6298**	2.4846	0.8400**
14	0.0107	-6.5238	-0.0152	-0.0671	-0.0118	-0.0038	-0.0005	0.0173	0.0027	-0.1273	-0.0511	0.7054	-0.5757	**7.0344**	0.3950

**Significant at 1 per cent level; *Significant at 5 per cent level; Residual effect = 0.4764

1.Vine length; 2.Number of primary branches; 3.Days to first male flower anthesis; 4.Days to first female flower anthesis; 5.Node at which first male flower anthesis; 6.Node at which first female flower anthesis; 7.Number of male flowers per vine; 8.Number of female flowers per vine; 9.Sex ratio; 10.Number of fruits per vine; 11.Fruit girth; 12.Fruit length; 13.Individual fruit weight; 14.Flesh thickness; 15.Yield per plant

Out of fifteen characters subjected to path analysis, the flesh thickness (7.0344) had a very high positive direct effect followed by the trait fruit length (1.6913) had moderate direct effect, whereas the traits such as days to first female flower anthesis (0.5456), node at which first female flower anthesis (0.0581) and sex ratio (0.0253), were recorded very low direct effect with yield per vine.Number of male flowers per vine (-0.0108), vine length (-0.1002), fruit girth (-0.1188), number of female flowers per vine (-0.2315), node at which first male flower anthesis (-0.3005), number of fruits per vine (-0.7445), days to first male flower anthesis (-1.3546), individual fruit weight (-1.6298) and number of primary branches (-6.8471) recorded negative direct effect on fruit yield per vine. The residual effect observed in present study was 0.3459.

The results of path analysis revealed that the positive and highest direct effect was exhibited in flesh thickness towards fruit yield. The positive direct effects were also exerted by fruit length, days to first female flower anthesis, node number at which first female flower anthesis and sex ratio. The negative direct effects were shown by vine length, number of primary branches, days to first male flower anthesis, node number at which first male flower anthesis, number of male flowers per vine, number of female flowers per vine, number of fruits per vine, fruit girth and individual fruit weight. The findings of Latif *et al*., 2008 [9] in ash gourd, Kothainayagi, 2013 [10] and Nagaraju *et al*., 2016 [4] in ash gourd reveals the same.

The fruit weight, fruit girth, number of fruits per vine and number of primary branches indirectly influences the flesh thickness and fruit length. Therefore it is suggested that the fruit characters such as flesh thickness, fruit length,

fruit weight, fruit girth and number of fruits per vine were considered as important traits which directly and indirectly influences the yield. The correlation study also confirms the same.

Conclusion

Ash gourd is an economically important crop in India with many medicinal properties. Yield is a complex entity governed by a number of other components in this crop. The association studies are useful in crops such as ash gourd when selection has to be exercised simultaneously for more than one character. From this study it was observed that the fruit characters such as flesh thickness, fruit length, fruit weight, fruit girth and number of fruits per vine were considered as important characters for crop improvement programme.

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