

Original Research Article

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Studies on Correlation and Path Analysis for Yield and its Contributing Traits in Brinjal (*Solanum melongena* L.)

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ABSTRACT

Keywords

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A field experiment of twenty genotypes of brinjal had done with an aim to study correlation and association analysis for fruit yield and its yield contributing characters so as to identify genotypes with desirable attributes for the utilization in crop improvement program during *kharif* 2017-18. Correlation studies revealed that traits like plant height, number of branches per plant, plant spread, number of fruit per plant, days to 50 % flowering, fruit length and fruit diameter had significant association with fruit yield per plant. The result of path coefficient analysis indicated that the traits like number of fruits per plant, number of branches per plant, plant spread (N-S) and days to 50% flowering should be considered essential for developing high yielding genotypes as they had high positive direct effects on fruit yield per plant. Thus, the fruit yield per plant can be improved by making selection of these characters during yield improvement programme.

Introduction

Brinjal (*Solanum melongena* L., $2n = 24$), a member of the Solanaceae family, is the most common and popular vegetable crop of India. It grown in almost all parts of India year-round and is a major source of income for small and marginal farmers. It is being grown extensively in India, Bangladesh, Pakistan, China and Philippines. India is the second major producer of brinjal in the world after China (Ravali *et al.*, 2017). Due to its highest production potential and availability of the produce to consumers, it is also called as poor man's vegetable (Kumar *et al.*, 2014). India is

a major producer of brinjal in the world and it is grown in area of 648 thousand hectares with estimated annual production of 12,303 thousand metric tonnes with a productivity of 18.98 metric tonnes per hectare. In Maharashtra, it is grown in an area of 35,859 hectare, with an annual production of 667,640 metric tonnes and productivity of 18.61 metric tonnes per hectare which is less than the national average (Anon., 2018-19).

An improvement in brinjal is normally achieved by selecting the genotypes with desirable character combination existing in the germplasm or by hybridization.

Correlation and path co-efficient analysis are the important biometrical technique to determine the yield components. The characters that are positively correlated with yield are considerably important to plant breeder for selection purpose. Correlation provides a measure of genetic association between the characters and reveals the traits that might be useful as an index of selection. A study of association of these characters helps in selection of genotypes and also suggests the advantage of a selection scheme for more than one character at a time, which could be explained that improvement of one character results in improvement of all positively related characters. In the present study, the simple correlation coefficients between yield and its components and their inter correlations among the components were estimated. Although the correlation co-efficient indicates the nature of association among the different traits, path analysis splits the correlation co-efficient into measure of direct and indirect effects thus providing understanding of the direct and indirect contribution of each character towards yield. Hence, the present study was under taken to unravel the correlation and path co-efficient of yield and yield attributing traits in brinjal.

Materials and Methods

The present investigation was carried out at Horticulture Research Scheme (Vegetable), Department of Horticulture, VNMKV, Parbhani, during the *kharif* season, 2017-18. The experiment was laid out in a Randomized Block Design with two replications. The experimental material comprised of twenty genotypes collected from IIVR, Varanasi and VNMKV, Parbhani. The 42 days old healthy seedlings of each genotype were transplanted with a spacing of 75cm x 60cm. The recommended package of practices was adopted for raising the crop. Observation were recorded in five randomly selected

plants for fourteen characters *viz.* plant height (cm), number of branches per plant, plant spread (cm), days to 50% flowering, fruit setting (%), number of fruit per plant, days to last harvest, fruit length (cm), fruit diameter (cm), fruit pedicel length (cm), ascorbic acid (mg/100g), total phenolic content (mg/100g), flavonoid content (mg/100g)and fruit yield per plant. Analysis of covariance for all combinations were done and used for estimation of correlations. The formula as suggested by Johnson *et al.*, (1955) was used for calculating simple correlation coefficient. Path analysis was done as per the procedure outlined by Dewey and Lu (1959).

Results and Discussion

In general, it was revealed that genotypic correlation coefficients were higher than phenotypic correlation coefficients. This could be interpreted on the basis that there was a strong inherent genotypic relationship between the characters studied, but their phenotypic expression was impeded by the influence of environmental factors. Plant height were exhibited positive significant correlation with number of branches per plant (0.1756 P, 0.2414 G), plant spread (N-S) (0.3567 P, 0.6487 G) and (E-W) (0.4954 P, 0.6720 G), number of fruit per plant (0.2495 P, 0.2470 G), fruit length (0.4871 P, 0.6231 G), fruit pedicel length (0.5174 P, 0.7608 G), ascorbic acid (0.2236 P, 0.3226 G)and fruit yield per plant (0.3115 P,0.2837 G).Ascorbic acid (0.3226 G) has recorded positive and significant association with plant height at genotypic level. In present experiment, it was observed that as the plant height increased, there was corresponding increase in number of branches per plant, plant spread, fruit length, fruit pedicel length, ascorbic acid and number of fruits per plant. The association recorded significant improvement in yield. Similar results were obtained in brinjal by (Saleem *et al.*, 2013).

Number of primary branches per plant were recorded positive, significant correlation with plant spread (N-S) (0.2298 P, 0.6638 G) and (E-W) (0.1431 P, 0.2928 G), number of fruit per plant (0.3106 P, 0.3716 G) and fruit yield per plant (0.4259 P, 0.5364 G). Negative and significant correlation was observed with days to 50 % flowering (-0.2767 P, -0.2568 G), Flavonoid content (-0.1846 G) were exhibited significant and negative association with number of branches per plant at genotypic level.

Days to 50 per cent flowering showed significant negative correlation with fruit diameter (-0.2888 P, -0.3093 G), fruit pedicel length (-0.3207 P, -0.3328 G) and fruit yield per plant (-0.3496 P, -0.4629 G) and showed significant positive correlation with days to last harvest (0.1421 P, 0.2967 G). Number of branches per plant shows significant and positive association with fruit yield per plant and negative significant correlation was also noticed with days to 50% flowering. Similar reports were also noticed by Umar Musa Tanko Momoh and Jimoh Yusuf (2015) and Madhavi *et al.*, (2015), Sawadogo *et al.*, (2016) in brinjal.

Number of fruit per plant showed positive significant correlation with fruit yield per plant (0.5352 P, 0.5738 G). Negative and significant correlation was noticed with days to last harvest (-0.3031 P, -0.3660 G), and fruit diameter (-0.3833 P, -0.4416 G). Length of fruit were recorded positive, significant correlation with fruit pedicel length (0.6182 P, 0.6633 G), and fruit yield per plant (0.3171 P, 0.3259 G).

Total phenolic content (-0.5710 G) and flavonoid content (-0.2222 G) has recorded negative and significant association was noticed with length of fruit at genotypic level. Diameter of fruit was recorded positive, significant correlation with ascorbic acid (0.2707 P, 0.2804 G) and fruit yield per plant

(0.1633 P, 0.1471 G). Ascorbic acid content showed positive significant correlation with flavonoid content (0.2461 P, 0.2484G). Fruit yield per plant was recorded positive significant correlation with characters plant height (0.3115 P, 0.2837 G), number of branches per plant (0.4259 P, 0.5364 G), plant spread (N-S) (0.5880 P, 0.8043 G) and (E-W) (0.5338 P, 0.5782 G) and fruit length (0.3171 P, 0.3259 G). Days to 50% flowering (-0.3496 P, -0.4629 G) and days to last harvest(-0.2347 P, -0.3346 G) has recorded negative and significant association with fruit yield per plant at phenotypic and genotypic level. Fruit yield per plant had exhibited highly significant and positive association with fruit circumference and fruit weight were recorded by Gupta *et al.*, (2015). The number of branches per plant and number of fruit per plant were significantly and positively associated with fruit yield both at phenotypic as well as genotypic level. Similar result was recorded by Pandey *et al.*, (2016).

Fruit yield per plant exhibited high significant positive association with plant height, number of branches per plant, plant spread, number of fruit per plant, fruit length, fruit diameter, fruit pedicel length and ascorbic acid. Number of fruits per plant, fruit length and diameter of fruit indicating the importance of these traits in selection for yield.

Direct selection based on these traits would result in simultaneous improvement of aforesaid traits and yield in brinjal. Similar results were reported in brinjal for different components *viz.*, association of fruit yield per plant with the number of branches per plant Samadia (2007), fruit length and fruit diameter (Shinde *et al.*, 2009), plant height and number of fruit per plant (Saleem *et al.*, 2013), association of fruit yield with number of branches (Patel *et al.*, 2015), number of fruit per plant and fruit weight, Reshmika (2015), and number of fruit per plant and fruit diameter (Sujin *et al.*, 2017) (Table 1–4).

Table.1 Genotypical correlation coefficient for different fruit yield contributing characters in brinjal

Characters	Plant height (cm)	Number of branches per plant	Plant spread (cm)		Days to 50% flowering	Fruit setting %	Number of fruit per plant	Days to last harvest	Fruit length (cm)	Fruit diameter (cm)	Fruit pedicel length (cm)	Ascorbic acid (mg)	Total phenolic content	Flavonoid content	Fruit yield per plant (g)	
			NS	EW												
Plant height (cm)	1.0000	0.2414*	0.6487*	0.6720**	-0.1859	-0.4784**	0.2495*	-0.0144	0.6231*	-0.3910**	0.7608**	0.3226**	-0.2257*	-0.0612	0.2837*	
Number of branches per plant		1.0000	0.6638*	0.2928*	-0.2568*	-0.0797	0.3716**	-0.0826	0.0134	0.0542	0.1669	-0.0086	0.0089	-0.1846	0.5364**	
Plant spread (cm) NS			1.0000	1.0292**	-0.1607	-0.1299	0.4065**	0.2411*	0.0458	-0.1454	-0.1859	0.0022	0.2785*	-0.0337	0.8043**	
				1.0000	-0.1333	-0.2355*	0.2441**	0.1670	0.1689	-0.1395	0.0856	0.1840	0.2144*	0.2147*	0.5782**	
EW					1.0000	0.0914	-0.2028*	0.2967**	0.0414	-0.3093**	-0.3328**	0.0448	-0.1093	0.0413	-0.4629**	
Days to 50% flowering						1.0000	-0.2469*	-0.0235	-0.0303	0.3289**	-0.0687	0.1178	0.1811	0.3042**	0.0269	
Fruit setting %							1.0000	-0.3660**	0.1246	-0.4416**	0.1133	-0.0547	0.2462*	-0.0195	0.5738**	
Number of fruit per plant								1.0000	-0.2947*	-0.0305	-0.4988**	-0.1468	0.1101	0.1968	-0.3346**	
Days to last harvest									1.0000	-0.4460**	0.6633**	-0.0046	-0.5710**	-0.2222**	0.3259**	
Fruit length (cm)										1.0000	-0.4283**	0.2804*	0.1226	0.0105	0.1471	
Fruit diameter (cm)											1.0000	-0.0435	-0.4144**	-0.2784*	0.1361	
Fruit pedicel length (cm)												1.0000	0.1558	0.2484*	0.1072	
Ascorbic acid (mg)													1.0000	0.5987**	0.0652	
Total phenolic content														1.0000	-0.1199	
Flavonoid content															1.0000	
Fruit yield per plant (g)																1.0000

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

Table.2 Phenotypical correlation coefficient for different fruit yield contributing characters in brinjal

Characters	Plant height (cm)	Number of branches per plant	Plant spread (cm)		Days to 50% flowering	Fruit setting %	Number of fruit per plant	Days to last harvest	Fruit length (cm)	Fruit diameter (cm)	Fruit pedicel length (cm)	Ascorbic acid (mg)	Total phenolic content	Flavonoid content	Fruit yield per plant (g)	
			NS	EW												
Plant height (cm)	1.0000	0.1756	0.3567**	0.4954**	-0.1570	-0.1943	0.2470*	-0.0452	0.4871**	-	0.3009**	0.5174**	0.2236*	-0.1720	-0.0466	0.3115**
Number of branches per plant		1.0000	0.2298*	0.1431	-0.2767*	0.0301	0.3106**	-0.0311	-0.0063	0.0419	0.1700	-0.0054	0.0082	-0.1716	0.4259**	
Plant spread (cm)			1.0000	0.7137**	-0.0459	-0.2187*	0.3555**	0.1673	0.0729	-0.0041	0.0419	0.0106	0.1544	-0.0187	0.5880**	
NS				1.0000	-0.0508	-0.3345**	0.3208**	0.1847	0.1782	-0.0465	0.1750	0.1609	0.1734	0.1737	0.5338**	
EW					1.0000	0.0501	-0.1336	0.1421	0.0204	-0.2888*	-	0.3207**	0.0642	-0.0985	0.0372	-0.3496**
Days to 50% flowering						1.0000	-0.2327*	0.0091	-0.0318	0.2313*	-0.0403	0.0464	0.1306	0.2194*	-0.0195	
Fruit setting %							1.0000	-0.3031**	0.1298	-0.3833**	0.1266	-0.0399	0.2332*	-0.0185	0.5352**	
Number of fruit per plant								1.0000	-0.2406*	0.0158	-0.3087**	-0.1477	0.0989	0.1768	-0.2347*	
Days to last harvest									1.0000	-0.3973**	0.6182**	0.0003	-0.5605**	-0.2181*	0.3171**	
Fruit length (cm)										1.0000	-0.2499*	0.2707*	0.1192	0.0102	0.1633	
Fruit diameter (cm)											1.0000	-0.0228	-0.3528**	-0.2370*	0.1377	
Fruit pedicel length (cm)												1.0000	0.1544	0.2461*	0.1020	
Ascorbic acid (mg)													1.0000	0.5987**	0.0579	
Total phenolic content														1.0000	-0.1065	
Flavonoid content															1.0000	
Fruit yield per plant (g)																1.0000

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

Table.3 Genotypic (G) path coefficient analysis indicating direct and indirect effects of components characters on fruit yield per plant in brinjal genotypes

Characters	Plant Height (cm)	Number of branches per plant	Plant spread (cm)		Days to 50% flowering	Fruit setting %	Number of fruit per plant	Days to last harvest	Fruit length (cm)	Fruit diameter (cm)	Fruit pedicel length (cm)	Ascorbic acid (mg)	Total phenolic content	Flavonoid content	Fruit yield per plant (g)
			NS	EW											
Plant height (cm)	-0.2734	-0.0660	-0.1773	-0.1837	0.0508	0.1308	-0.0682	0.0039	-0.1704	0.1069	-0.2080	-0.0882	0.0617	0.0167	0.2837
Number of branches per plant	0.0202	0.0836	0.0555	0.0245	-0.0215	-0.0067	0.0311	-0.0069	0.0011	0.0045	0.0140	-0.0007	0.0007	-0.0154	0.5364
Plant spread (cm)	0.1477	0.1512	0.2277	0.2344	-0.0366	-0.0296	0.0926	0.0549	0.0104	-0.0331	-0.0423	0.0005	0.0634	-0.0077	0.1832
	-0.9570	-0.4169	-1.4658	-1.4242	0.1898	0.3355	-0.4046	-0.2379	-0.2406	0.1986	-0.1219	-0.2621	-0.3053	-0.3058	-0.8235
Days to 50% flowering	-0.0149	-0.0206	-0.0129	-0.0107	0.0803	0.0073	-0.0163	0.0238	0.0033	-0.0249	-0.0267	0.0036	-0.0088	0.0033	-0.0372
Fruit setting %	2.0778	0.3461	0.5644	1.0230	-0.3968	-4.3430	1.0721	0.1022	0.1314	-1.4283	0.2984	-0.5115	-0.7865	-1.3212	0.0269
Number of fruit per plant	0.2078	0.3095	0.3386	0.2366	-0.1689	-0.2056	0.8330	-0.3049	0.1041	-0.3678	0.0943	0.0456	0.2051	-0.0163	0.5352
Days to last harvest	0.1049	0.6001	-1.7504	-1.2129	-2.1545	0.1709	2.6577	-7.2615	2.1400	0.2215	3.6221	1.0662	-0.7996	-1.4289	-0.3346
Fruit length (cm)	-0.4883	-0.0105	-0.0359	-0.1324	-0.0324	0.0237	-0.0979	0.2309	-0.7836	0.3494	-0.5197	0.0036	0.4474	0.1741	0.3259
Fruit diameter (cm)	0.1810	-0.0251	0.0673	0.0646	0.1432	-0.1523	0.2045	0.0141	0.2065	-0.4630	0.1983	-0.1298	-0.0568	-0.0048	0.1471
Fruit pedicel length (cm)	0.1197	0.0263	-0.0293	0.0135	-0.0524	-0.0108	0.0178	-0.0785	0.1044	-0.0674	0.1574	-0.0069	-0.0652	-0.0438	0.1361
Ascorbic acid (mg)	0.0883	-0.0023	0.0006	0.0504	0.0123	0.0322	-0.0150	-0.0402	-0.0013	0.0767	-0.0119	0.2737	0.0426	0.0680	0.1072
Total phenolic content	0.0664	-0.0026	-0.0820	-0.0631	0.0322	-0.0533	-0.0725	-0.0324	0.1681	-0.0361	0.1220	-0.0459	-0.2944	-0.1763	0.0652
Flavonoid content	0.0297	0.0897	0.0164	-0.1043	-0.0201	-0.1478	0.0095	-0.0956	0.1079	-0.0051	0.1352	-0.1207	-0.2908	-0.4857	-0.1199

Residual effect =0.2227

Table.4 Phenotypic (P) path coefficient analysis indicating direct and indirect effects of components characters on fruit yield per plant in brinjal genotypes

Characters	Plant Height (cm)	Number of branches per plant	Plant spread (cm)		Days to 50% flowering	Fruit setting %	Number of fruit per plant	Days to last harvest	Fruit length (cm)	Fruit diameter (cm)	Fruit pedicel length (cm)	Ascorbic acid (mg)	Total phenolic content	Flavonoid content	Fruit yield per plant (g)
			NS	EW											
Plant height (cm)	-0.1639	-0.0288	-0.0585	-0.0812	0.0257	0.0318	-0.0405	0.0074	-0.0799	0.0493	-0.0848	-0.0367	0.0282	0.0076	0.3115
Number of branches per plant	0.0242	0.1379	0.0317	0.0197	-0.0382	0.0042	0.0428	-0.0043	-0.0009	0.0058	0.0235	-0.0007	0.0011	-0.0237	0.4259
Plant spread (cm)	0.0402	0.0259	0.1126	0.0803	-0.0052	-0.0246	0.0400	0.0188	0.0082	-0.0005	0.0047	0.0012	0.0174	-0.0021	0.5880
	-0.2686	-0.0776	-0.3869	-0.5421	0.0275	0.1813	-0.1739	-0.1001	-0.0966	0.0252	-0.0949	-0.0872	-0.0940	-0.0942	0.5338
Days to 50% flowering	-0.0077	-0.0136	-0.0023	-0.0025	0.0493	0.0025	-0.0066	0.0070	0.0010	-0.0142	-0.0158	0.0032	-0.0049	0.0018	-0.3496
Fruit setting %	0.4566	-0.0708	0.5141	0.7861	-0.1179	-2.3503	0.5469	-0.0215	0.0748	-0.5437	0.0947	-0.1092	-0.3070	-0.5156	-0.0195
Number of fruit per plant	0.1731	0.2177	0.2492	0.2248	-0.0937	-0.1631	0.7009	-0.2159	0.0910	-0.2686	0.0887	-0.0279	0.1634	-0.0130	0.5738
Days to last harvest	0.1702	0.1171	-0.6309	-0.6963	-0.5359	-0.0345	1.1617	-3.7703	0.9071	-0.0595	1.1638	0.5567	-0.3730	-0.6665	-0.2347
Fruit length (cm)	-0.0969	0.0013	-0.0145	-0.0355	-0.0041	0.0063	-0.0258	0.0479	-0.1990	0.0791	-0.1230	0.0001	0.1115	0.0434	0.3171
Fruit diameter (cm)	0.0855	-0.0119	0.0012	0.0132	0.0820	-0.0657	0.1088	-0.0045	0.1128	-0.2840	0.0710	-0.0769	-0.0339	-0.0029	0.1633
Fruit pedicel length (cm)	0.0117	0.0038	0.0009	0.0039	-0.0072	-0.0009	0.0029	-0.0070	0.0140	-0.0056	0.0226	-0.0005	-0.0080	-0.0054	0.1377
Ascorbic acid (mg)	0.0019	0.0000	0.0001	0.0013	0.0005	0.0004	-0.0003	-0.0012	0.0000	0.0023	-0.0002	0.0084	0.0013	0.0021	0.1020
Total phenolic content	-0.0180	0.0009	0.0161	0.0181	-0.0103	0.0136	0.0244	0.0103	-0.0586	0.0125	-0.0369	0.0162	0.1045	0.0626	0.0579
Flavonoid content	0.0138	0.0507	0.0055	-0.0513	-0.0110	-0.0648	0.0055	-0.0522	0.0644	-0.0030	0.0700	-0.0727	-0.1768	-0.2953	-0.1065

Residual effect =0.2725

The overall perusal of correlation analysis results in brinjal indicated that traits like plant height, number of branches per plant, plant spread, number of fruit per plant, days to 50 % flowering, fruit length and fruit diameter had significant association with fruit yield per plant which indicated that the adequate knowledge of interrelationship between fruit yield per plant and its components themselves is useful for selection and simultaneous improvement in these characters. Similar results were reported in brinjal by Umar Musa Tanko Momoh and Jimoh Yusuf (2015) Sawadogo *et al.*, (2016) and Shivkumar *et al.*, (2016).

The estimation of correlation indicates only the extent and nature of association between yield and its components but does not show the direct and indirect effects of different yield attributes on yield *per se*. Fruit yield is dependent on several characters which are mutually associated; these will in turn impair the true association existing between a component and fruit yield. A change in any one component is likely to disturb the whole network of cause and effect. Thus, each component has two paths of action *viz.*, the direct influence on fruit yield, indirect effect through components which are not revealed from the correlation studies (Lenka and Mishra 1973).

Number of branches had a positive direct effect (0.0836) on fruit yield per plant. It showed a maximum positive indirect effect through characters *viz.*, plant spread(N-S) (0.0555), number of fruit per plant (0.0311) and plant spread (E-W) (0.0245) followed by plant height (0.0202). Positive direct effect (0.0803) on fruit yield was exerted by days to 50 per cent flowering and it had maximum positive indirect effect on fruit yield through days to last harvest (0.0238) followed by fruit setting percent (0.0073), and ascorbic acid (0.0036). Number of fruits per plant had a

positive direct effect (0.8330) on fruit yield per plant. While, it showed maximum negative indirect effect through fruit diameter (-0.3678) followed by days to last harvest (-0.3049) and fruit setting percent (-0.2056) at genotypic level. Ascorbic acid content was recorded positive direct effect (0.2737) on fruit yield per plant. It had exerted highest positive indirect effect on fruit yield per plant through plant height (0.0883), fruit diameter (0.0767) and flavonoid content (0.0685).

The traits like number of branches per plant, plant spread (N-S), days to 50% flowering, number of fruit per plant, fruit pedicel length, ascorbic acid exhibited positive direct effects on fruit yield per plant and these traits recorded significant, positive correlation with fruit yield per plant. This suggested that direct selection based on these characters would be effective for an increase in yield, similar results were also reported in brinjal by Shende *et al.*, (2014), Ravali *et al.*, (2017) and Yadav *et al.*, (2017).

Plant height, plant spread (EW), fruit setting percent, days to last harvest, fruit length, fruit diameter, total phenolic content and flavonoid content showed positive indirect effects on fruit yield per plant. This suggested that indirect selection based on these character will be effective in yield improvement. Similar results were reported in brinjal by Prabhu *et al.*, (2008), Lakshmi *et al.*, (2014) and Tripathy *et al.*, (2018). Out of all characters studied, path analysis revealed that the traits like number of fruits per plant, number of branches per plant, plant spread (N-S), days to 50% flowering and ascorbic acid content was directly contributing to yield.

From the present investigation it is concluded that correlation coefficient and path coefficient for fruit yield per plant and its attributes in brinjal genotypes indicated the

presence of ample variability for most of the traits. Correlation studies revealed that traits like plant height, number of branches per plant, plant spread, number of fruit per plant, days to 50 % flowering, fruit length and diameter of fruit had significant association with fruit yield per plant. The result of path coefficient analysis indicated that the traits like number of fruits per plant, number of branches per plant, plant spread (N-S) and days to 50% flowering should be considered essential for developing high yielding genotypes as they had high positive direct effects on fruit yield per plant.

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