International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 705-709

Received: 27-07-2017
Accepted: 28-08-2017

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Assessment of heritability, genetic advance, correlation and path analysis in pointed gourd (*Trichosanthes dioica* Roxb.)

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Abstract
Thirty six genotypes of pointed gourd collected from different indigenous sources were grown in Augmented Block Design II with three checks during summer-rainy season, 2015. The accessions were assessed to know the nature and magnitude of genetic variability, correlation and path analysis for different horticultural traits. The days to first fruiting ranged from 56.60 to 75.00, number of nodes at first flowering (4.49-11.82), fruit length (4.91-10.32 cm) and average fruit weight varied from 20.76 g (PPG-15) to 53.93 g (PPG-9). Wide range of variation for number of primary branches (3.99-10.19), vine length (4.24-9.93 m), fruit weight per plant (2.56-8.28 kg), fruit yield per hectare (9.54 to 31.22 t) were found in the germplasms. A narrow range of genetic differences between the PCV and GCV indicates that the traits are mostly governed by genetic factors with minimum environmental influence on the phenotypic expression of these traits. High genetic advance coupled with high heritability was found for number of fruits per plant, nodes per vine, average fruit weight and days to first female flowering suggested that there is high scope for improvement in these characters through direct phenotypic selection. Fruit weight per plant (0.99), number of fruits per plant (0.75), fruit length (0.61) and nodes per vine (0.32) were highly significant and positively correlated with the fruit yield. The genotypic path coefficient showed a direct positive effect by traits like fruit length (0.61), fruit circumference (0.38), average fruit weight (0.51), number of primary branches (0.36), nodes per vine (0.32), number of fruits per plant (0.75), fruit weight per plant (0.99) on fruit yield, whereas seed weight per fruit (-0.37) showed a direct negative effect on fruit yield.

Keywords: Pointed gourd, Heritability, Genetic advance, Correlation and path analysis, *Trichosanthes dioica* Roxb.

Introduction

Among cucurbitaceous vegetables pointed gourd is known as ‘’king of gourds’’, is one of the most important and valuable crop. Pointed gourd is generally grown in Uttar Pradesh, West Bengal, Bihar, Assam and lesser part in Odisha, Maharashtra and Gujarat (Nath and Subramanayam, 1972) [17]. It is one of the most nutritive cucurbit vegetables and is native to Indian subcontinent. Its fruits are rich in vitamin A (153 IU), protein (2%), vitamin C (2%), fat (0.3%) per 100 g of edible portion. According to Choudhury (1996)[5], 100 g fresh weight of edible fruits contains P (40 mg), Ca (30 mg), Na (2.6 mg), Mg (9 mg), K (83 mg), Cu (1.1 mg), S (17 mg), Cl (4 mg) and also provides 20 kcal energy. It was reported that pointed gourd possesses the medicinal property of lowering the total cholesterol and blood sugar, cure blood and skin diseases (Chandrasekar *et al*., 1988) [4]. Very meagre genetic information is available on the improvement for yield and their attributing characters in this crop, Keeping in view the importance of the crop, the present study was carried out to estimate the genetic variability, correlation and path analysis in pointed gourd for various yield attributing characters in pointed gourd.

Materials and methods

The present study was undertaken during summer-rainy season, 2015 at Vegetable Research Centre of G.B.P.U.A & T., Pantnagar. Thirty six genotypes of pointed gourd were grown in Augmented Block Design II with three checks (Kashi Alankar, Swarna Rekha and Rajendra Parwal-1) which were arranged in six blocks, each block possess six genotypes and three checks. A total of 36 genotypes of pointed gourd were collected from different states of India (Uttar Pradesh, Bihar and Jharkhand). The plants were planted at a spacing of 2.5mx1m. The plant population in the experimental field had female and male plants at the ratio of 9:1 to

9:1 to ensure effective pollination. Statistical analysis to estimate the variance and correlation coefficients was carried out according to the method suggested by Burton (1952) [3] and Panse and Sukhatme (1961) [18], respectively. Path coefficient analysis was followed as explained by Dewey and Lu (1959) [9], while heritability (broad sense) and expected genetic advance were worked out as suggested by Lush (1940) [14] and Johnson *et al.* (1955) [11], respectively.

Results and discussion

A good amount of genetic diversity exists in the land races or strains of pointed gourd in centre of diversity. Thus existing genetic variability offers much scope for the systematic improvement of pointed gourd.

Analysis of variance

Analysis of variance for twenty yield attributing characters are presented in Table 1. Among all the characters studied almost all the characters showed highly significant values in check varieties except seed weight per fruit which shows non-significant value. The significant differences suggest the existence of variability present for different traits which gives opportunity for improvement of yield in pointed gourd.

Table 1: Analysis of variance (ANOVA) for different characters of pointed gourd genotypes

Sl. No.	Characters	Mean sum of square		
		Block (5)	Check (3)	Error (10)
1	Days to first female flowering	41.50	62.19**	13.62
2	No. of nodes at first flowering	11.60	31.28**	1.06
3	Days to first fruiting	58.79	220.36**	34.63
4	Female flower length (cm)	0.60	3.35**	0.19
5	Fruit length (cm)	14.23	1.82**	0.27
6	Fruit diameter (cm)	0.14	0.35**	0.0852
7	Fruit circumference (cm)	1.91	9.77**	0.8454
8	Average fruit weight (g)	220.68	157.21**	17.96
9	Fruit dry matter (%)	4.68	3.21**	0.23
10	TSS (ºBrix)	1.05	2.32**	0.06
11	No. of primary branches	9.43	2.93**	0.63
12	Inter-nodal length (cm)	4.82	42.80**	0.75
13	Vine length (m)	0.21	1.46*	0.58
14	Nodes per vine	79.37	1182.19**	38.55
15	Seeds per fruit	20.42	101.87**	3.85
16	Seed weight per fruit (g)	0.42	0.36	0.48
17	100 seed weight (g)	7.86	4.66**	0.64
18	No. of fruits per plant	16275.65	8602.27**	446.13
19	Fruit weight per plant (kg)	8.01	3.10**	0.16
20	Fruit yield per hectare (t)	152.12	47.30**	3.73

* Significant at 5% level of probability
** Significant at 1% level of probability

Genetic parameters analysis

Mean, range, phenotypic and genotypic coefficient of variation, heritability and genetic advance for different genetic parameters of thirty nine genotypes are presented in Table 2.

General mean, Range

Days to female flowering ranged from 45.51 to 63.91 days with an average mean of 53.81 days. Number of nodes at first flowering ranged from 4.49 to 11.82 with a grand mean of 7.38. A wide range of variation (4.91 to 10.32 cm) was recorded for fruit length with a grand mean of 8.05 cm. Fruit diameter ranged from 2.71 to 4.24 cm with a grand mean of 3.43 cm. Number of fruits per plant ranged from 105.76 to 345.29 with a grand mean of 226.48. Wide range (2.56 to 8.29 kg) of variation was recorded for fruit weight per plant with a grand mean of 5.18 kg. Fruit yield per hectare ranged from 9.54 to 31.22 t with a grand mean of 19.71 t. Similarly, a wide range of variability is also reported by Bharathi and Vishalnath (2011) [2], Yadav (2013) [24] and Singh *et al.* (2014) [20].

Coefficient of Variation

Among all the twenty characters, high phenotypic coefficient of variation and genotypic coefficient of variation were observed for seed weight per fruit (26.641, 23.828), number of nodes at first flowering (23.362, 22.930), number of fruits per plant (22.572, 22.373), fruit yield per hectare (22.427, 22.202), moderate values of PCV and GCV were recorded for number of primary branches (18.504, 18.179), inter-nodal length (11.480, 11.207), vine length (16.159, 15.773) and lower range were found for days to first fruiting (6.314, 5.640), days to first female flowering (7.503, 7.180), fruit dry matter (7.884, 7.563).

In general, PCV was found higher than the GCV which indicate that the predominance role of environment on the expression of characters, but the genotypic coefficient of variation provides the major genetic variability.

Those traits, for which PCV and GCV are low, provide evidence for lack of sufficient variability in the germplasm stocks. Hence, the variability has to be generated through introduction and hybridization of diversified genotypes to generate trasgressive segregants.

A wide difference between PCV and GCV was observed for seed weight per fruit (26.641, 23.828), days to first fruiting (6.314, 5.640), fruit diameter (8.292, 7.844), number of nodes at first flowering (23.362, 22.930), fruit circumference (10.039, 9.660). A wide range of differences indicate that the predominance of environment on the expression of traits.

Comparatively, the differences are low between PCV and GCV for the traits namely fruit weight per plant (22.404, 22.264), total soluble solid (11.362, 11.176), 100 seed weight (16.309, 16.108), number of fruits per plant (22.572, 22.373), fruit yield per hectare (22.427, 22.202), seeds per fruit (21.862, 21.617). A narrow range of differences between PCV and GCV revealed that the traits are mostly governed by genetic factors with minimum influence from environment on phenotypic expression of these traits. So, selection of these traits on the basis of phenotypic expression can be effective.

The present findings are similar to that earlier work of Khule *et al.* **(**2011**)** [12]**,** who observed high magnitude of genotypic and phenotypic variation for days to appear first male flower, number of fruits per plant, fruit length. Similarly, variation were observed for number of nodes per plant (Dora *et al*., 2003) [9], number of fruits per plant (Malek *et al*., 2007) [15].

Heritability

Broad sense heritability values for different traits varied from 79.78 to 98.75%. Fruit weight per plant (98.75) was the most heritable trait, whereas days to first fruiting (79.78) was the least heritable character. The estimation of heritability for all the traits is high indicating minimum environmental influence in expression of these traits and shows that the traits would exhibit high response to selection. These findings are in conformity with Choudhary *et al.* (2008) [5] for fruit weight and fruit length, Kumar *et al.* (2011) [13] for fruit yield per plant.

Genetic Advance

The genetic advance was recorded maximum for the traits like number of fruits per plant (98.968), nodes per vine (21.854), average fruit weight (14.356), fruit yield per hectare (8.744), while it was minimum for the traits like fruit diameter (0.524) followed by seed weight per fruit (0.807), female flower length (0.867), total soluble solid (0.867).

The highest value of genetic advance as percent of mean among the traits was obtained for number of nodes at first flowering (46.361), number of fruits per plant (45.681), fruit weight per plant (45.576), fruit yield per hectare (45.278) and lowest value was obtained for the traits like days to first fruiting (10.376), days to first female flowering (14.154), fruit dry matter (14.944), fruit diameter (15.285). The high value of genetic advance shows that there is less role of environment and predominant role of additive genetic component in expression of these characters. So, phenotypic selection can be effective to improve those traits. High heritability coupled with high genetic advance was observed for number of fruits per plant, nodes per vine, average fruit weight, days to first female flowering. High heritability with high genetic advance indicated the predominant role of additive genetic component in expression of these traits. Hence, there is scope for improvement of these traits through phenotypic selection.

Low heritability coupled with low genetic advance was observed in traits like fruit diameter, seed weight per fruit, fruit dry matter, fruit circumference. Low heritability with low genetic advance for many growth parameters indicated that these traits are governed by non-additive gene action where little progress would be achieved by applying selection pressure on these traits. The improvement on these traits would be more effective by selecting specific combinations followed by among mating of lines.

A similar results of high heritability coupled with high genetic advance was observed for TSS, pulp thickness, weight of fruit (Muralidhara *et al.*, 2014) [16], number of fruits per plant, average fruit weight and fruit length (Ahsan *et al*., 2014) [1].

Correlation coefficient analysis

The ultimate aim of the breeding programme is to increase the yield per unit area. Yield is a complex trait and it is controlled by association of number of components. Therefore, for incremental advance towards increase in yield, selection has to be made for various components of yield since there may not be genes for yield perse, but only for various yield attributing characters (Grafius, 1959) [10].

The estimates of correlation coefficients were worked out among twenty economic traits in pointed gourd and are presented in Table 3. Highly significant and positive correlation were found between fruit yield per hectare and fruit weight per plant (0.998), number of fruits per plant (0.751), fruit length (0.608), average fruit weight (0.506). However, it had negative and significant correlation with seed weight per fruit (-0.370). The study shows that selections for the characters like fruit weight per plant, number of fruits per plant, fruit length, average fruit weight, fruit circumference, number of primary branches, nodes per vine positively related to yield would be effective to get more yield per hectare. Similarly, those characters which are positively related to days to first fruiting are effective in selection to get early varieties.

Similarly, Yadav *et al.* (2013**)** [25] found that vine length had significant and positive correlation with inter-nodal length, number of nodes per vine, fruit width and number of fruits per vine. Similar work was also done by Resmi and Srelathakumary (2012) [19].

Path coefficient analysis

Association of characters determined by correlation indicates the association pattern of component traits with yield. It simply represents the general association of a particular trait with yield rather than providing cause and effect relation. It may not provide an exact picture of the relative significance of direct and indirect influence of each of the yield attributing components towards yield. In order to find a clear picture of inter-relationships among the fruit yield and yield contributing characters, direct and indirect effects were worked out using path analysis. The technique of path coefficient of analysis was developed by Wright (1934) [23] and demonstrated by Dewy and Lu (1959) [8].

The estimates of genotypic path coefficient were worked out among twenty economic traits in pointed gourd and are presented in Table 4. Fruit weight per plant had a direct positive effect (0.998) on yield. It showed positive indirect effect on yield through number of fruits per plant (0.701), fruit length (0.572) and negative indirect effect through inter-nodal length (-0.253), seeds per fruit (-0.236). Number of fruits per plant showed a direct positive effect (0.751) on yield. It also showed positive indirect effect through inter-nodal length (0.020), seed weight per fruit (0.014) and negative indirect effect through number of primary branches (-0.022), nodes per vine (-0.020). The result showed that in genotypic path coefficient the yield is significantly positive directly affected by fruit length, fruit circumference, average fruit weight, number of primary branches, nodes per vine and number of fruits per plant. Hence, selection for any of these independent traits leads to improving the genotypes for fruit yield per plant.

On contrary, Seed weight per fruit exhibited a direct negative effect (-0.370) on yield. It showed negative indirect effect via number of fruits per plant (-0.083), fruit weight per plant (-0.128), female flower length (-0.074), average fruit weight (-0.128) and positive indirect effect on yield through total soluble solid (0.070), seeds per fruit (0.268), 100 seed weight (0.166), which indicates the seed weight per fruit should be low to improve yield.

These findings, in general, are in conformity with earlier reports of Singh *et al.* (2015) [21] in bitter gourd, Choudhury *et al.* (2014) [7] in ridge gourd, Sundaram (2010) [22] in bitter gourd.

Table 2: Estimation of coefficient of variation and other genetic parameters in pointed gourd genotypes

Sl. No.	Characters	General mean	Range	Coefficient of Variation			Heritability %	Genetic Advance	G.A. as % mean
				PCV%	GCV%	ECV%			
1	Days to1st female flowering	53.81	45.51-63.91	7.503	7.180	2.177	91.58	7.587	14.154
2	No.of nodes at 1st flowering	7.38	4.49-11.82	23.362	22.930	4.471	96.34	3.379	46.361
3	Days to first fruiting	65.78	56.60-75.00	6.314	5.640	2.839	79.78	6.800	10.376
4	Female flower length (cm)	4.47	3.41-5.78	10.412	9.917	3.172	90.72	0.867	19.458
5	Fruit length (cm)	8.05	4.91-10.32	16.052	15.915	2.093	98.30	2.582	32.505

6	Fruit diameter (cm)	3.43	2.71-4.24	8.292	7.844	2.689	89.49	0.524	15.285
7	Fruit circumference (cm)	10.66	7.03-12.99	10.039	9.660	2.734	92.58	2.036	19.147
8	Average fruit weight (g)	36.05	20.76-53.93	20.335	19.981	3.776	96.55	14.356	40.445
9	Fruit dry matter (%)	6.90	5.96-8.11	7.884	7.563	2.228	92.02	1.038	14.944
10	TSS (°Brix)	3.82	2.98-5.35	11.362	11.176	2.048	96.75	0.867	22.645
11	No. of primary branches	7.27	3.99-10.19	18.504	18.179	3.453	96.52	2.685	36.791
12	Inter-nodal length (cm)	10.95	8.25-14.27	11.480	11.207	2.492	95.29	2.486	22.535
13	Vine length (m)	6.92	4.24-9.93	16.159	15.773	3.512	95.28	2.180	31.716
14	Nodes per vine	65.72	47.96-90.56	16.870	16.597	3.022	96.79	21.854	33.636
15	Seeds per fruit	18.93	7.80-27.20	21.862	21.617	3.266	97.77	8.368	44.031
16	Seed weight per fruit (g)	1.86	0.36-2.85	26.641	23.828	11.915	80.00	0.807	43.902
17	100 seed weight (g)	10.05	3.58-14.49	16.309	16.108	2.556	97.54	3.262	32.772
18	No. of fruits per plant	226.48	105.76-345.29	22.572	22.373	2.992	98.24	98.968	45.681
19	Fruit weight per plant (kg)	5.18	2.56-8.29	22.404	22.264	2.502	98.75	2.316	45.576
20	Fruit yield per hectare (t)	19.71	9.54-31.22	22.427	22.202	3.165	98.01	8.744	45.278

Table 3: Genotypic correlation among different pairs of characteristics of pointed gourd

	DFFF	NNFF	DFF	FFL	FL	FD	FC	AFW	FDM	TSS	NPB	INL	VL	NPV	SPF	SWPF	100SW	NFPP	FWPP
DFFF	1.000	0.242	0.883**	0.228	0.039	-0.124	0.222	0.217	-0.116	0.145	-0.268*	0.152	0.060	-0.069	0.178	-0.034	0.011	-0.170	-0.051
NNFF	0.242	1.000	0.191	0.106	0.245	-0.074	0.031	0.184	0.165	0.029	0.074	-0.118	0.223	0.287	-0.116	-0.222	0.394**	0.073	0.200
DFF	0.883**	0.191	1.000	0.245	0.090	-0.121	0.251	0.250	-0.132	0.357**	-0.253	0.099	0.018	-0.022	0.147	0.109	-0.027	0.023	0.043
FFL	0.228	0.106	0.245	1.000	0.296*	0.238	0.204	0.333*	-0.198	0.038	0.219	0.224	0.055	-0.161	-0.268	-0.231	0.002	-0.072	0.248
FL	0.039	0.245	0.090	0.296*	1.000	0.348**	0.363**	0.588**	-0.101	-0.047	-0.052	-0.003	-0.246	-0.123	-0.313*	-0.345*	-0.159	0.195	0.607**
FD	-0.124	-0.074	-0.121	0.238	0.348**	1.000	0.684**	0.561**	-0.289*	-0.151	0.212	-0.119	-0.015	0.047	-0.017	-0.096	-0.194	-0.141	0.272*
FC	0.222	0.031	0.251	0.204	0.363**	0.684**	1.000	0.583**	-0.260	0.001	0.106	-0.147	-0.019	0.091	-0.106	-0.208	-0.211	0.132	0.364**
AFW	0.217	0.184	0.250	0.333*	0.588**	0.561**	0.583**	1.000	-0.282*	-0.023	0.035	-0.101	0.060	0.115	-0.180	-0.400**	-0.101	-0.003	0.498**
FDM	-0.116	0.165	-0.132	-0.198	-0.101	-0.289*	-0.260	-0.282*	1.000	-0.032	-0.047	0.195	-0.172	-0.158	-0.123	-0.215	0.039	0.148	0.014
TSS	0.145	0.029	0.357**	0.038	-0.047	-0.151	0.001	-0.023	-0.032	1.000	0.078	-0.123	0.376**	0.314*	0.225	0.219	0.077	0.393**	0.145
NPB	-0.268*	0.074	-0.253	0.219	-0.052	0.212	0.106	0.035	-0.047	0.078	1.000	-0.291*	0.281*	0.342*	-0.218	-0.274*	-0.140	0.415**	0.362*
INL	0.152	-0.118	0.099	0.224	-0.003	-0.119	-0.147	-0.101	0.195	-0.123	-0.291*	1.000	-0.055	-0.667**	-0.025	0.039	0.016	-0.379**	-0.268
VL	0.060	0.223	0.018	0.055	-0.246	-0.015	-0.019	0.060	-0.172	0.376**	0.281*	-0.055	1.000	0.650**	0.370**	0.109	0.184	0.105	0.150
NPV	-0.069	0.287*	-0.022	-0.161	-0.123	0.047	0.091	0.115	-0.158	0.314*	0.342*	-0.667**	0.650**	1.000	0.122	-0.140	-0.007	0.375**	0.321*
SPF	0.178	-0.116	0.147	-0.268	-0.313*	-0.017	-0.106	-0.180	-0.123	0.225	-0.218	-0.025	0.370**	0.122	1.000	0.833**	0.285*	-0.163	-0.250
SWPF	-0.034	-0.222	0.109	-0.231	-0.345*	-0.096	-0.208	-0.400**	-0.215	0.219	-0.274*	0.039	0.109	-0.140	0.833**	1.000	0.515**	-0.258	-0.398**
100SW	0.011	0.394**	-0.027	0.002	-0.159	-0.194	-0.211	-0.101	0.039	0.077	-0.140	0.016	0.184	-0.007	0.285*	0.515**	1.000	-0.270*	-0.272*
NFPP	-0.170	0.073	0.023	-0.072	0.195	-0.141	0.132	-0.003	0.148	0.393**	0.415**	-0.379**	0.105	0.375**	-0.163	-0.258	-0.270*	1.000	0.744**
FWPP	-0.051	0.200	0.043	0.248	0.607**	0.272*	0.364**	0.498**	0.014	0.145	0.362**	-0.268	0.150	0.321*	-0.250	-0.398**	-0.272*	0.744**	1.000
FYPH	-0.055	0.197	0.031	0.262	0.608**	0.262	0.376**	0.506**	0.027	0.142	0.363**	-0.264	0.150	0.325*	-0.252	-0.370**	-0.266	0.751**	0.998**

DFFF (Days to first female flowering), NNFF (Number of nodes at first flowering), DFF (Days to first fruiting), FFL (Female flower length), FL (Fruit length), FD (Fruit diameter), FC (Fruit circumference), AFW (Average fruit weight), FDM (Fruit dry matter), TSS (Total soluble solid), NPB (Number of primary branches), INL (Inter-nodal length), VL (Vine length), NPV (Nodes per vine), SPF (Seeds per fruit), SWPF (Seed weight per fruit), 100SW (100 seed weight), NFPP (Number of fruits per plant), FWPP (Fruit weight per plant), FYPH (Fruit yield per hectare)

Table 4: Genotypic path co-efficient analysis among different fruit yield attributes of pointed gourd

	DFFF	NNFF	DFF	FFL	FL	FD	FC	AFW	FDM	TSS	NPB	INL	VL	NPV	SPF	SWPF	100SW	NFPP	FWPP
DFFF	-0.257	-0.062	-0.274	-0.059	-0.010	0.032	-0.057	-0.056	0.030	-0.037	0.064	-0.039	-0.016	0.018	-0.046	0.009	-0.003	0.044	0.013
NNFF	0.007	0.030	0.006	0.003	0.007	-0.002	0.001	0.005	0.005	0.001	0.002	-0.004	0.007	0.009	-0.003	-0.007	0.012	0.002	0.006
DFF	0.233	0.042	0.219	0.054	0.020	-0.027	0.055	0.055	-0.029	0.078	-0.055	0.022	0.004	-0.005	0.032	0.024	-0.006	0.005	0.009
FFL	0.011	0.005	0.012	0.050	0.015	0.012	0.010	0.017	-0.010	0.002	0.011	0.011	0.003	-0.008	-0.013	-0.012	0.000	-0.004	0.012
FL	0.001	0.009	0.003	0.011	0.036	0.013	0.013	0.021	-0.004	-0.002	-0.002	0.000	-0.009	-0.004	-0.011	-0.013	-0.006	0.007	0.022
FD	0.022	0.013	0.021	-0.041	-0.061	-0.174	-0.119	-0.098	0.038	0.026	-0.037	0.021	0.003	-0.008	0.003	0.017	0.034	0.024	-0.047
FC	0.023	0.003	0.026	0.021	0.038	0.071	0.104	0.061	-0.027	0.000	0.011	-0.015	-0.002	0.010	-0.011	-0.022	-0.022	0.014	0.038
AFW	0.027	0.023	0.031	0.042	0.074	0.071	0.073	0.126	-0.028	-0.003	0.004	-0.013	0.008	0.014	-0.023	-0.050	-0.013	0.000	0.063
FDM	-0.014	0.020	-0.016	-0.024	-0.013	-0.027	-0.032	-0.027	0.123	-0.004	-0.006	0.024	-0.021	-0.020	-0.015	-0.027	0.005	0.018	0.002
TSS	-0.016	-0.003	-0.040	-0.004	0.005	0.017	0.000	0.003	0.004	-0.112	-0.009	0.014	-0.042	-0.035	-0.025	-0.025	-0.009	-0.044	-0.016
NPB	-0.011	0.003	-0.012	0.010	-0.002	0.010	0.005	0.002	-0.002	0.004	0.046	-0.013	0.013	0.016	-0.010	-0.012	-0.006	0.019	0.016
INL	-0.001	0.000	0.000	-0.001	0.000	0.000	0.001	0.000	-0.001	0.000	0.001	-0.004	0.000	0.002	0.000	0.000	0.000	0.001	0.001
VL	0.005	0.017	0.001	0.004	-0.019	-0.001	-0.001	0.005	-0.013	0.028	0.021	-0.004	0.075	0.049	0.028	0.008	0.014	0.008	0.011
NPV	-0.005	0.020	-0.002	-0.011	-0.008	0.003	0.006	0.008	-0.011	0.022	0.024	-0.046	0.045	0.069	0.008	-0.010	0.000	0.026	0.022
SPF	-0.029	0.019	-0.024	0.044	0.052	0.003	0.018	0.030	0.020	-0.037	0.036	0.004	-0.061	-0.020	-0.165	-0.138	-0.047	0.027	0.041
SWPF	-0.011	-0.071	0.035	-0.074	-0.111	-0.031	-0.067	-0.128	-0.069	0.070	-0.088	0.013	0.035	-0.045	0.268	0.321	0.166	-0.083	-0.128
100SW	-0.002	-0.056	0.004	0.000	0.023	0.027	0.030	0.014	-0.005	-0.011	0.020	-0.002	-0.026	0.001	-0.041	-0.073	-0.142	0.038	0.039
NFPP	0.009	-0.004	-0.001	0.004	-0.010	0.008	-0.007	0.000	-0.008	-0.021	-0.022	0.020	-0.006	-0.020	0.009	0.014	0.014	-0.053	-0.040
FWPP	-0.048	0.189	0.041	0.234	0.572	0.257	0.343	0.469	0.013	0.137	0.342	-0.253	0.141	0.303	-0.236	-0.375	-0.257	0.701	0.943
FYPH	-0.055	0.197	0.031	0.262	0.608**	0.262	0.376**	0.506**	0.027	0.142	0.363**	-0.264	0.150	0.325*	-0.252	-0.370**	-0.266	0.751**	0.998**

Genotypic residual effect = 0.0301, DFFF (Days to first female flowering), NNFF (Number of nodes at first flowering), DFF (Days to first fruiting), FFL (Female flower length), FL (Fruit length), FD (Fruit diameter), FC (Fruit circumference), AFW (Average fruit weight), FDM (Fruit dry matter), TSS (Total soluble solid), NPB (Number of primary branches), INL (Inter-nodal length), VL (Vine length), NPV (Nodes per vine), SPF (Seeds per fruit), SWPF (Seed weight per fruit), 100SW (100 seed weight), NFPP (Number of fruits per plant), FWPP (Fruit weight per plant), FYPH (Fruit yield per hectare).

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