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Short communication

Genetic variability in physico-chemical characteristics of some pummelo collections from Mizoram

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ABSTRACT

A study was carried out to during 2009-2010 to identify the elite pummelo genotypes among its natural population in different districts of Mizoram. During fruiting season, ripe fruits of 12 selected collections were analyzed for different physico-chemical traits, *viz.*, Significant variation was observed for physical parameters, *viz.*, individual fruit weight ranged from 393.89-903.48 g; fruit diameter 8.16-14.01cm; fruit volume 449.47-998.03 cc; pulp: peel ratio 0.56-1.72 and seed number 12.67-37.50. Similarly, among the chemical parameters, juice content varied from 18.83-41.93%; ascorbic acid 17.40-52.70 mg/100 g; acidity 0.81-1.80%, total sugars 6.09-8.65% and sugar: acid ratio from 3.60-10.30. Wide range of variation in physico-chemical parameters of pummelo collections indicated the great scope of individual plant selection based on these characters for future genetic improvement programme.

Key words: *Citrus grandis*, pummelo, physico-chemical characteristics, variability, Mizoram.

Pummelo [*Citrus grandis* (L.) Osbeck] is one of the popular citrus species grown in the tropical and subtropical regions of the world. Fresh red pummelo juice is an excellent source of antioxidant compounds and exhibited great efficiency in scavenging different forms of free radicals including DPPH, superoxide anion, and hydrogen peroxide radicals (Tsai *et al.*, 11). In India, the plant is abundantly found in North-eastern states in foot hills up to the altitude of 1,500 m above msl (Singh and Singh, 10). Diverse forms of pummelo have been frequently observed growing in lower hills of Assam, Meghalaya, Manipur and Tripura (Borthakur, 2; Singh and Singh, 10). Hore *et al.* (4) reported maximum diversity of pummelo in western parts of Aizawl district of Mizoram and Jampui hills area of north Tripura. Among all north-eastern states, in Mizoram, the pummelo trees are found growing wild or semi- wild in marginal land or in home gardens without any commercial cultivation. As majority of pummelo trees are from seedling origin, therefore they showed a tremendous variation in their morphology and physico-chemical traits among its population. The rich gene pools incorporating extensive variability from basic ingredients are important for improvement programmes (Kumar, 5). Keeping all the above points in mind, the present investigation was carried out to evaluate pummelo genotypes form different locations of Mizoram for physico-chemical parameters.

The present investigation was carried out at the Department of Horticulture, Aromatic and Medicinal Plants, Mizoram University, Aizawl during 2009-10. Survey work was carried out in different districts of Mizoram in their natural population during the fruiting season to identify the elite pummelo genotypes. Fully matured fruits were collected from selected trees to study the physico-chemical characteristics. Five fruits of each accession replicated five times were used for analyzing the physical characteristics. The fruit weight, pulp weight and peel weight were taken with the help of an electronic balance. The fruit length, fruit diameter, peel and pulp thickness were recorded by using Vernier calipers. The fruit volume was measured by dipping the fruit in water through water displacement method. Pulp: peel ratio was determined by dividing the pulp weight by peel weight and expressed in percentage. The juice was extracted from the fruit with the help of juice extractor. The TSS was recorded with the help of a hand refractometer. The standard AOAC (1) methods were followed to determine the titrable acidity, ascorbic acid reducing, non-reducing and total sugars. The data were statistically analyzed as per the method of Panse and Sukhatme (6).

Physical parameters of 12 pummelo collections are given in Table 1. The analysis of variance showed a significant difference among the parameters. The highest fruit weight (903.48 g) was recorded in MZU-P-8 among all the collections, followed by MZU-P-3 (855.50 g) and MZU-P-2 (725.55 g). The lowest fruit weight was obtained in MZU-P-1 (393.89 g). This finding is in agreement with the findings of Hore *et al.*

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Table 1. Variability in physical and morphological characteristics of fruits among pummelo collections.

Genotype	Fruit weight (g)	Fruit length (cm)	Fruit dia. (cm)	Fruit vol. (cc)	Pulp: peel ratio	Peel wt. (g)	Pulp wt. (g)	No. of segments	Peel thickness (cm)	Pulp thickness (cm)	No. of seeds/ fruit
MZU-P-1	393.89	11.77	12.03	467.68	1.16	182.45	211.45	14.27	3.96	8.07	35.03
MZU-P-2	725.55	11.88	12.16	794.85	1.20	329.28	396.29	14.37	3.54	8.62	30.55
MZU-P-3	855.50	12.58	12.85	932.08	1.28	374.86	400.63	13.72	3.01	9.84	12.67
MZU-P-4	441.07	7.82	8.80	532.17	0.56	282.46	158.61	17.47	3.87	4.93	16.38
MZU-P-5	519.13	8.72	8.89	584.88	1.08	248.86	270.27	14.67	3.74	5.15	32.73
MZU-P-6	394.92	7.52	8.18	449.47	0.97	200.48	194.44	15.53	3.23	4.95	28.05
MZU-P-7	432.90	9.64	10.68	478.9	0.68	256.86	176.04	15.67	4.09	6.59	16.68
MZU-P-8	903.48	13.75	14.01	998.03	1.72	332.4	571.08	10.92	3.05	10.96	15.33
MZU-P-9	462.53	9.53	10.10	533.45	0.92	240.48	222.05	10.85	3.28	6.82	31.07
MZU-P-10	551.25	11.18	12.73	617.49	1.22	248.48	302.77	13.58	3.56	9.17	21.87
MZU-P-11	781.43	11.59	12.70	893.28	1.02	386.89	394.54	12.57	3.81	8.89	26.32
MZU-P-12	685.07	12.41	13.18	769.25	0.75	392.48	292.59	11.53	4.13	9.05	37.50
$CD_{0.05}$	39.55	0.34	0.32	26.16	0.10	5.97	8.35	0.39	0.14	0.09	5.43

(4), and Singh and Sheo Govind (7). The accessions ranged between 7.52-13.75 cm in respect to fruit length. The maximum value was recorded in MZU-P-8 (13.75 cm) which was significantly higher than all other genotypes. MZU-P-3 (12.58 cm) and MZU-P-12 (12.41 cm) followed it. The lowest fruit length was obtained in MZU-P-6 (7.52 cm). This variation in fruit length might be due to different genetic make up of the genotypes. This finding is in conformity with the finding of Singh and Singh (9). Maximum fruit diameter was recorded in MZU-P-8 (14.01 cm) which was significantly higher than all of the collections. It was followed by MZU-P-12 (13.18 cm) and MZU-P-3 (12.85 cm) and the minimum was recorded in MZU-P-6 (8.16 cm). Among the genotypes, the highest fruit volume was observed in MZU-P-8 (998.03 cc), followed by MZU-P-3 (932.08 cc) and MZU-P-11 (893.28 cc) and the lowest (449.47 cc) was in MZU-P-6. Singh and Singh (13) reported wide range of variability among pummelo genotypes from NEH region of India in fruit volume. Peel weight of the genotypes ranged between 182.45 - 392.48 g and MZU-P-12 recorded the maximum peel weight (392.48 g), which was significantly higher than most of the accessions except MZU-P-11 (386.89 g) with which it was statistically *at par*. The minimum peel weight was recorded in MZU-P-1 (182.45 g). Our finding is in agreement with the findings of Singh and Sheo Govind (7), and Singh and Singh (9). Similarly, accession MZU-P-8 recorded the maximum pulp weight of 571.08 g. MZU-P-3 (400.63 g) and MZU-P-12 (392.48 g) followed it, while MZU-P-7 recorded the lowest pulp weight (176.04 g). Pulp: peel ratio is one of the important physical parameter which determines the quality of the fruit. In the present study, the highest pulp: peel ratio of 1.72 was recorded in MZU-P-8, which was followed by MZU-P-3 (1.28), and the lowest was in MZU-P-4 (0.56). Similarly, maximum peel thickness of 4.13 cm was observed in MZU-P-12, which was significantly higher. It was followed by MZU-P-7 (4.09 cm). The lowest peel thickness was recorded by MZU-P-3 (3.01 cm). Genotypes MZU-P-8 recorded the maximum pulp thickness (10.96 cm), followed by MZU-P-3 (9.84 cm) and MZU-P-12 (9.05 cm) and the lowest was recorded in MZU-P-4 (4.93 cm). The lowest value were recorded in MZU-P-9 (10.85). These findings are in conformity with the findings of Singh and Singh (10). Genotypes MZU-P-12 recorded the highest number of seed per fruit (37.50). It was followed by MZU- H-1 (35.03) and the lowest seeds per fruit was observed in MZU-P-3 (12.67), followed by MZU-P-8 (15.33). The analysis of variance presented in Table 1 revealed a correlation among fruit weight and pulp weight. The genotypes produced higher fruit weight may be due to more pulp weight. This clearly indicated that, during selection of any genotype based on fruit, the breeder should give emphasis on fruit pulp content rather than fruit weight alone. This finding is in conformity with Hazarika *et al.* (3).

The chemical parameters of different pummelo fruits are presented in Table 2. Among all the accessions, MZU-P-3 recorded the highest juice content of 41.93 per cent. MZU-P-8 (38.67%) and MZU-P-12 (36.55%) followed it. MZU-P-2 recorded the lowest value (18.83%). Similarly, genotype MZU-

P-12 recorded the maximum TSS (11.37%). It was followed by MZU-P-8 (10.04%) and MZU-P-3 (9.87%), while the minimum was observed in MZU-P-11 (6.83%). The variation in TSS may be due to genetic make up of plant. Hore *et al.* (4), and Singh and Sheo Govind (11), reported variation in TSS among different pummelo collections from north east India. Ascorbic acid is also one of the most important criteria, which also determine the quality of fruits. Among all genotypes, MZU-P-12 recorded the maximum value (52.70 mg/100 g). It was followed by MZU-P-3 (47.51 mg/100 g) and MZU-P-8 (45.90 mg/100 g). The lowest ascorbic acid was recorded in MZU-P-5 (17.40 mg/100 g). In our study, titrable acidity of the fruit ranged from 0.81-1.80 per cent. MZU-P-6 recorded the maximum (1.80), while minimum (0.81) was in MZU-H-8. This is a fact in many fruits that, when TSS are increasing acidity is definitely decreased. This may be major factor for minimum acid content in MZU-P-8, MZU-P-3 and MZU-P-12 and variation among genotypes for acidity might be due to higher TSS and genetic make of plant. Similarly, maximum value of reducing sugar was recorded in MZU-P-3 (5.81%) and the minimum was in MZU-P-2 (2.49%). The highest value of non-reducing sugar was observed in MZU-P-1 (3.86%). Total sugars of the fruits was recorded in the range of 6.09-8.65 per cent with maximum in MZU-P-3 (8.65%). It was followed by MZU-P-8 (7.93%) and MZU-P-12 (7.74%). The lowest total sugars were observed in MZU-P-2 (6.09%). The variation in total sugars among the accessions may be due to genetic makeup of plant. The highest sugar: acid ratio was recorded in MZU-P-3 (10.30) followed by MZU-P-8 (9.79) and MZU-P-12 (8.41), while lowest was in MZU-P-2 (3.60%). These findings are in agreement with the findings of Singh and Sheo Govind (7), and Singh and Singh (8).

Preference of consumers always depends on physical parameters of fruits like fruit weight, fruit diameter, pulp content and pulp peel ratio of pummelo. Similarly, consumers also prefer the fruit with less seeds. Likewise, among the biochemical constituents, consumers always like the fruits with high juice content, ascorbic acid, low acidity and high sugar: acid ratio. Therefore, from the present investigation, by considering all above parameters, MZU-P-8, MZU-P-3 and MZU-P-12 can be selected as superior pummelo genotypes from Mizoram for uses in various purposes.

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Table 2. Variability in chemical characteristics of fruits among pummelo collections.

Genotype	Juice (%)	TSS (%)	Ascorbic acid (mg/100 g)	Acidity (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugars (%)	Sugar: acid ratio
MZU-P-1	35.03	8.81	28.82	1.28	3.24	3.86	7.10	5.54
MZU-P-2	18.83	9.22	19.22	1.69	2.49	3.60	6.09	3.60
MZU-P-3	41.93	9.87	47.51	0.84	5.81	2.84	8.65	10.3
MZU-P-4	19.05	8.85	26.87	1.35	3.92	3.04	6.96	5.15
MZU-P-5	26.07	7.40	17.40	1.25	4.59	2.96	7.55	6.04
MZU-P-6	28.05	8.48	35.15	1.80	3.90	2.94	6.84	3.80
MZU-P-7	26.68	8.35	41.68	1.54	3.62	3.57	7.19	4.67
MZU-P-8	38.67	10.04	45.90	0.81	5.39	2.54	7.93	9.79
MZU-P-9	34.40	9.23	36.83	1.13	5.25	1.87	7.12	6.30
MZU-P-10	25.20	8.98	21.71	1.24	4.06	2.76	6.82	5.50
MZU-P-11	20.32	6.83	28.98	1.45	4.56	2.85	7.41	5.11
MZU-P-12	36.55	11.37	52.70	0.92	4.36	3.38	7.74	8.41
$CD_{0.05}$	6.23	2.02	6.32	0.07	0.33	0.21	0.40	0.20

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