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Quality and chemical properties of Tuberose (*Polianthes tuberosa* L.) affected by genotypes x date of sowing interactions

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Abstract
Highly significant variations due to genotypes, dates of sowing and years had been observed by analysis of variance for field evaluation of tuberose genotypes at various dates of sowings for quality and chemical properties at CCS Haryana Agricultural University, Hisar during 2019 and 2020 cropping seasons. Number of bulbs increased for all the genotypes over the dates of sowings and the maximum number of bulbs was noticed for Mexican single. Positive change had observed for Bulb diameter with latter dates of sowings in both years and deviation from 16.8 to 22.9 expressed in mean values in the combined analysis. Weight of bulbs increased for all the genotypes and the maximum number of bulbs was noticed for Mexican single during May month sowings. Bulbs yield per clump has maintained positive change for all genotypes with latter dates of sowings as varied from 236.7 to 826.1 in the overall values. Maximum specific gravity (0.995) was exhibited by Mexican single for the May sowings as specific gravity increased for all the genotypes. Refractive Index has showed positive change for all genotypes with latter dates of sowings in both years. Combined analysis has seen variation from 17.6 to 20.4 in Acid value for tuberose genotypes. Deviation from 220 to 236 showed by genotypes for Easter values over dates of sowings over the study periods of two years.

Keywords: *Polianthes tuberosa*, essential oil, specific gravity, refractive index, pH of oil

Introduction

Tuberose or *Polianthes tuberosa* L. has been widely cultivated for pleasant and intense floral fragrance (Kumar *et al.*, 2021) [7]. Due to its sweet-smelling floral fragrance, this Amaryllidaceae species is cultivated in the tropics and subtropics at commercial scale especially as cut flowers (Dogra *et al.*, 2020) [4]. The intensely fragrant floral terminal spike of Tuberose is used as a biotic source for indoor fragrance (Jadhav *et al.*, 2020) [5]. In addition, floral wax and essential oils of Tuberose are in high demand for the production of expensive perfumes and cosmetics (Bharathi *et al.*, 2019) [3]. The emitted volatiles of full bloomed P. tuberosa flowers are dominated by benzyl benzoate, methyl benzoate, benzyl salicylate and methyl salicylate (Madhumathi *et al.*, 2018) [8]. Very sweet flower odor known to improve an individual's capacity for emotional depth and can stimulate the right side of the brain and bring serenity to the mind and heart. It also contains anti-inflammatory and antispasmodic properties. The great potential of tuberose i.e. cut-flower and essential oil for industry has been very well established in world markets. Need not to highlight the huge domestic consumption in different forms of loose flowers, cut flowers and concrete, absolute and essential oil, it has great potential in terms of export trade (Naik *et al.*, 2018) [10]. Now days, the flowers are being used for the extraction of the valuable natural aromatic oil much needed for the high cost perfume industry (Qureshi *et al.*, 2018) [11]. Essential oils are also known as volatile oils as used in perfumes, cosmetics, soaps and other products.

Materials and Methods

Genotypes performance varied from one date of sowing to another due to varying climatic conditions of the country over the time period. Experiment of present study consisted of six promising genotypes sown at three dates of sowings at Experimental Farm of the Department of Horticulture, CCS Haryana Agricultural University, Hisar during 2019 and 2020 cropping seasons to study flowering traits characters. Plant to plant spacing of 30 cm x 30cm was maintained in net plot size of 1.5m x 1.5m as trails was laid out with three replications with to accommodate twenty five plants per plot.

The recommended agronomical practices were adopted to raise the crop. Five random plants were selected for recording physical and chemical traits *viz*., Number of bulbs, bulb Diameter, bulb Weight, bulbs yield per clump, Specific Gravity, Refractive Index, pH of oil, Acid value, Easter Value etc. Reputed statistical software SAS version 9.3 along with JMP 9 was exploited for analysis and graphical presentations.

Results and Discussion

Highly significant effects of genotypes, dates of sowing and years over study were observed by analysis of variance (Meena *et al*., 2018) [9]. Since there are three factors, interactions among the factors were also significant as observed in Table 1. First order interactions of genotypes with dates of sowing and years showed the significance of mean squares of factors as compared to error mean squares. Second order interactions also exhibited their significance as compared to error mean squares of error for the combined analysis.

Number of bulbs

The data presented in Table 2 depict that different dates of sowings significantly affected the number of bulbs in tuberose and more numbers of bulbs witnessed with increasing dates of sowing during the first year. The maximum number of bulbs (28) was noticed for Mexican single where the minimum number of bulbs (9) was found for Pearl double (Figure 1). Dates of sowing had expressed an advantage of 09 to 14, 15 to 18, 24 to 29, 19 to 23, 18 to 20 and 15 to 18 for respective genotypes. The significantly minimum number of bulbs (09) was recorded in Pearl double tuberose for March sowing during second year of study, while the significantly maximum number of bulbs (28) was recorded for Mexican single. Number of bulbs increased for all the genotypes and the maximum number of bulbs (33) was noticed for Mexican single when dates of sowings advanced to the May month. Nearly minimum of 04 bulbs advantage was noticed for all the genotypes. Combined analysis has seen variation from 11.4 to 28.1 in average number of bulbs for tuberose genotypes. Dates of sowing had witnessed increase from 16.8 to 20.5 number of bulbs though marginal increase from 17.9 to 19.3 for years of study. Overall deviation from 9.3 to 30.5 had been expressed by genotypes over dates of sowings for the years of study (Table 2). The variation in number of bulbs produced per clump might be due to genetic factor which is further modified by prevailing environmental condition and the results are in consonance with finding of (Ahmad *et al.*, 2019) [1] in tuberose.

Bulb diameter

Minimum bulb diameter expressed by Pearl double for march sowing as compared to maximum value of Mexican Single (Figure 2). Genotypes exhibited an increase in bulb diameter from March to May sowing. Approximately 4 mm increase observed for Pearl double from March to May sowing whereas 16 to 19, 21 to 24, 18 to 21, 17 to 19, 17 to 21 for left over genotypes respectively. The data pertaining to bulb diameter are presented in Table 03, which indicated that bulb diameter of tuberose significantly increased with advancing of dates of sowing in second year, being maximum at May sowing and it was noticed minimum when genotypes planted in March month. The maximum bulb diameter (26) was recorded in Mexican single (23) by Prajwal, 22 for Hyderabad double and Vaibhav. Bulb diameter has showed positive change for all genotypes with latter dates of sowings in both years. Deviation from 16.8 to 22.9 expressed by genotypes in overall mean of genotypes in the combined analysis (Table 3). Dates of sowings had maintained an increase from 18.1 to 21.2 for bulb diameter of genotypes (Khan *et al.*, 2020) [6]. Values varied from 18.4 to 22.8 for average bulb diameter of genotypes over the years. An overall deviation observed from 15.2 to 24.1 for spike weight among genotypes over the dates of sowing over a period of two years.

Bulbs weight

Table 4 depicted that different dates of sowings significantly affected the bulbs weight in tuberose and more weights of bulbs witnessed with increasing dates of sowing during the first year. The maximum weight of bulbs (30) was noticed for Mexican single where the minimum weight of bulbs (16) was found for Hyderabad double (Figure 3). Dates of sowing had expressed an advantage of 18 to 22, 16 to 19, 28 to 31, 23 to 27, 20 to 23 and 19 to 22 for respective genotypes. Minimum advantage of an increase of 4 was noticed for genotypes for May sowing. The significantly minimum weight of bulbs (17) was recorded in Hyderabad double for March sowing during second year of study, while the significantly maximum weight observed to be of (32) was recorded for Mexican single. Weight of bulbs increased for all the genotypes and the maximum number of bulbs (33) was noticed for Mexican single when dates of sowings advanced to the May month. Nearly minimum of 04 bulbs advantage was noticed for all the genotypes. Combined analysis has seen variation from 17.8 to 29.2 in average weight of bulbs for tuberose genotypes. Dates of sowing had witnessed increase from 21 to 24.5 weight of bulbs though marginal increase from 21.5 to 24.0 for years of study. Overall deviation from 16.3 to 31.1 had been expressed by genotypes over dates of sowings for the years of study. The variation in bulb weight per plant among different genotype at bulb harvesting stage might be due to the distinguished varietal genetic makeup with more leaves to improve photosynthetic activity, source sink relationship to accumulate more carbohydrate and prevailing condition (Ali *et al.*, 2019) [20].

Yield per clump

Minimum bulbs yield per clump expressed by Pearl double for March sowing as compared to maximum bulbs yield per clump of Mexican Single (Figure 4). Genotypes exhibited an increase in bulbs yield per clump from March to April and further increase to May sowing of genotypes. Approximately 250 increase observed for Pearl double from March to May sowing whereas 180 to 300, 200 to 400, 650 to 880, 410 to 600, 350 to 480, 300 to 400 for the respective genotypes. The data pertaining to at different dates of sowings presented in Table 5, indicated that bulbs yield per clump of tuberose significantly increased with advancing of dates of sowing in second year, being maximum at May sowing and it was noticed minimum when genotypes planted in March month. The maximum bulbs yield per clump (1000) was recorded in Mexican single (710) by Prajwal, 520 by Suvasini, 480 by Vaibhav, 400 for Hyderabad double, 310 for Pearl double. Bulbs yield per clump has showed positive change for all genotypes with latter dates of sowings in both years (Zamin *et al*. 2020) [13]. Deviation from 236.7 to 826.1 expressed by genotypes in overall mean of bulbs yield per clump in the combined analysis (Table 5). Dates of sowings had maintained an increase from 370.8 to 521.5 for Bulbs yield per clump of genotypes. Values varied from 404.2 to 486.3 for average Bulbs yield per clump of genotypes over the years. An overall deviation observed from 174.4 to 952.2 for Bulbs yield per clump among genotypes over the dates of sowing over a period of two years.

Specific Gravity

Specific gravity of essential oil is described as the ratio between weight oil and water in the same volume of water and oil (Rosalind *et al.*, 2018) [12]. Table 6 depicted that different dates of sowings significantly affected the specific gravity and increased had witnessed with advancing dates of sowing during the first year. The maximum Specific Gravity (0.99) was noticed for Mexican single where the minimum of (0.905) was found for Hyderabad double (Figure 5). Dates of sowing had expressed an advantage of 0.91 to 0.925, 0.905 to 0.92, 0.97 to 0.99, 0.95 to 0.97, 0.92 to 0.93 and 0.93 to 0.945 for respective genotypes. Minimum advantage of an increase of 0.01 was noticed for all the genotypes for May sowing. The significantly minimum Specific Gravity (0.92) was recorded in Hyderabad double for March sowing during second year of study, while the significantly maximum observed to be of (0.995) was recorded for Mexican single. Specific Gravity increased for all the genotypes and the maximum Specific Gravity (0.995) was noticed for Mexican single when dates of sowings advanced to the May month. Combined analysis has seen variation from 0.91 to 0.99 in average Specific Gravity of bulbs for tuberose genotypes. Dates of sowing had witnessed increase from 0.93 to 0.95 Specific Gravity of bulbs though marginal increase from 0.94 to 0.95 for years of study. Overall deviation from 0.91 to 1.00 had been expressed by genotypes over dates of sowings for the years of study.

Refractive Index

Refractive index is the ratio between sine of angle of incidence and sine of the angle of refraction when a certain wavelength of light entering oil from the air with certain unchanged angle in maintained temperature (Bharathi *et al.*, 2019) [3]. The measurement of refractive index is purposed to decide the oil purity. Minimum Refractive Index expressed by Hyderabad double for march sowing as compared to maximum Refractive Index of Mexican Single (Figure 6). Genotypes exhibited an increase in Refractive Index from March to April and further increase from April to May dates of sowing. Approximately 0.01 increase observed for Pearl double from March to May sowing whereas 1.44 to 1.46, 1.49 to 1.52, 1.465 to 1.48, 1.46 to 1.475, 1.47 to 1.485 for remaining genotypes. The data pertaining to Refractive Index at different dates of sowing presented in Table 07, indicated an increase in Refractive Index of tuberose with advancing of dates of sowing in second year, being maximum at May sowing and it was noticed minimum when genotypes planted in March month. The maximum Refractive Index (1.525) was recorded in Mexican single (1.50) by Prajwal, 1.49 by Vaibhav, nearly 1.48 by Pearl double & Suvasini, least observed for Hyderabad double. Refractive Index has showed positive change for all genotypes with latter dates of sowings in both years. Deviation from 39.2 to 59.1 expressed by genotypes in overall mean of genotypes in the combined analysis (Table 7). Dates of sowings had maintained an increase from 1.46 to 1.50 for Refractive Index of genotypes. Values varied from 1.47 to 1.48 for average Refractive Index of genotypes over the years. An overall deviation observed from 1.44 to 1.51 for spike weight among genotypes over the dates of sowing over a period of two years.

pH of oil

Only marginal increase observed for pH of oil values for genotypes over the dates of sowing. Minimum value expressed by Pearl double for march sowing as compared to maximum value of Mexican Single (Figure 7). Genotypes exhibited an increase pH of oil from March to April and further increase from April to May sowing. Approximately increase observed for 4.6 to 4.8, 4.9 to 5.2, 5.5 to 5.6, 5.4 to 5.5, 5.1 to 5.3, 5.2 to 5.4 by genotypes from March to May sowing during first year. The maximum value 5.6 was recorded in Mexican single while least value of 4.7 by Pearl double for the second year. A positive change had been expressed for all the genotypes with latter dates of sowings in both years. Deviation from 4.7 to 5.5 expressed by genotypes in overall mean of genotypes in the combined analysis (Table 8). Dates of sowings had maintained an increase from 5.1 to 5.2 for pH of oil of genotypes. Values varied from 40.1 to 44.7 for average spike weight of genotypes over the years. An overall deviation observed from 4.6 to 5.5 for pH among genotypes over the dates of sowing over a period of two years.

Acid values

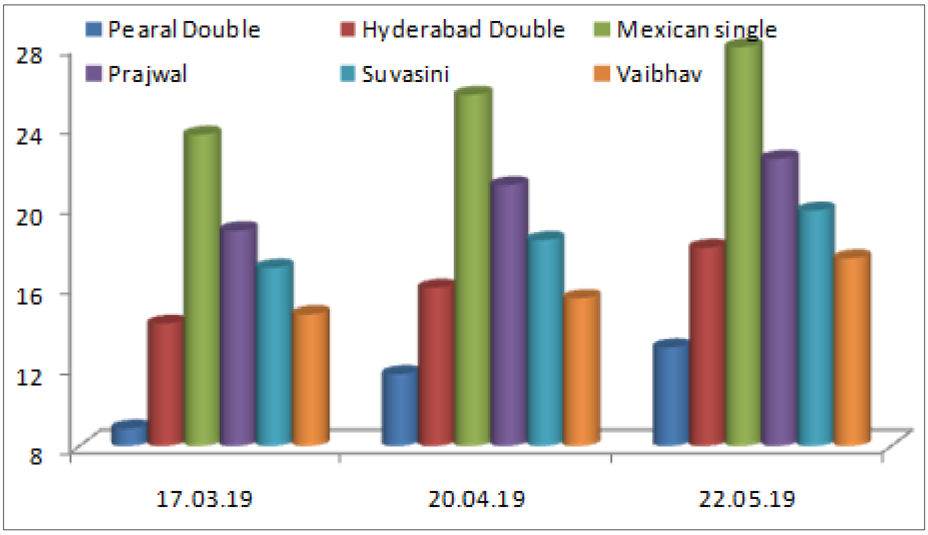
Determining the fatty acid can be used for knowing the quality of oil or fat, it is because the acid number is useful to measure and find the value of free fatty acid on material or sample. The higher value of fatty acid means there is a higher intensity of free fatty acid in the sample (Kumar *et al.,* 2021) [7]. The data presented in Table 9 depicted changes in Acid values of genotypes over different dates of sowings significantly. However the difference from 17.6 to 20.1 observed among genotypes even for March sowing in the first year. Approximately increase from 17.7 to 18.0. 17.6 to 17.8, 20.1 to 20.5, 19.3 to 19.5, 18.1 to 18.4, 18.8 to 19.1 expressed by genotypes from March to May sowing. The maximum value of Mexican single for May was sowing and minimum by Hyderabad double for March sowing exhibited in figure 8. Dates of sowing had expressed an advantage of 17.9 to 18.1, 17.8 to 17.95, 20.5 to 20.7, 19.4 to 19.7, 18.1 to 18.4 and 18.6 to 18.8 for respective genotypes. The significantly minimum was recorded in Hyderabad double tuberose for March sowing during second year of study, while the significantly maximum was recorded for Mexican single in May sowing. Combined analysis has seen variation from 17.6 to 20.4 in average Acid value for tuberose genotypes. Dates of sowing had witnessed increase from 18.6 to 18.8 with marginal change from 18.6 to 18.7 for years of study. Overall deviation from 17.6 to 20.6 had been expressed by genotypes over dates of sowings for the years of study (Table 9).

Easter value

Ester value is the number of milligram of hydroxide (Mg KOH) that is needed to saponify the ester which contained in a gram of oil. The decision of ester value is very important to determine the value of essential oil. The data presented in Table 10 expressed nearly same pattern of deviation for Easter value among the genotypes for March to May sowing. Marginal change had been expressed by genotypes over the different dates of sowing. The maximum value was noticed for Mexican single where the minimum was found for Hyderabad double (Figure 9). Dates of sowing had expressed only very marginal advantage of respective genotypes. The least value was recorded in Pearl double tuberose for March sowing during second year of study, while the higher value was recorded for Mexican single. The higher values were noticed for the May month sowing of genotypes. Overall deviation from 220.3 to 236.6 had been expressed by genotypes over dates of sowings for the years of study (Table 10). Deviation from 220 to 236 showed by genotypes over dates of sowings over the study periods of two years.

Table 1: Significance level of mean sum of square for flowering traits

Source	df	Number of bulbs per clump	Diameter of bulb (cm)	Weight of bulb (g)	Bulb Yield per clump (g)	Specific gravity	Refractive index	pH of oil	Acid value	Ester value
Genotypes (G)	5	566.47	72.391	308.47	843721	0.01383	0.00446	1.40322	21.048	703.729
Date of sowing (D)	2	117.77	91.165	111.64	204568	0.00213	0.00324	0.17325	0.420	2.171
Year (Y)	1	49.34	157.23	167.19	181653.80	0.0030	0.0035	0.0254	0.3108	0.000
G x D interaction	10	1.5141	0.5013	0.5316	4971.9	0.00001	0.00002	0.00188	0.007	0.110
G x Y interaction	5	9.47	5.62	8.13	13277.22	0.0001	0.0000	0.0004	0.0598	0.000
G x D x Y interaction	10	0.1061	0.227	0.5588	322.4	0.00001	0.00001	0.00030	0.006	0.000
Error	70	0.32	0.45	0.39	356.44	0.0000	0.0000	0.0003	0.0005	0.0014



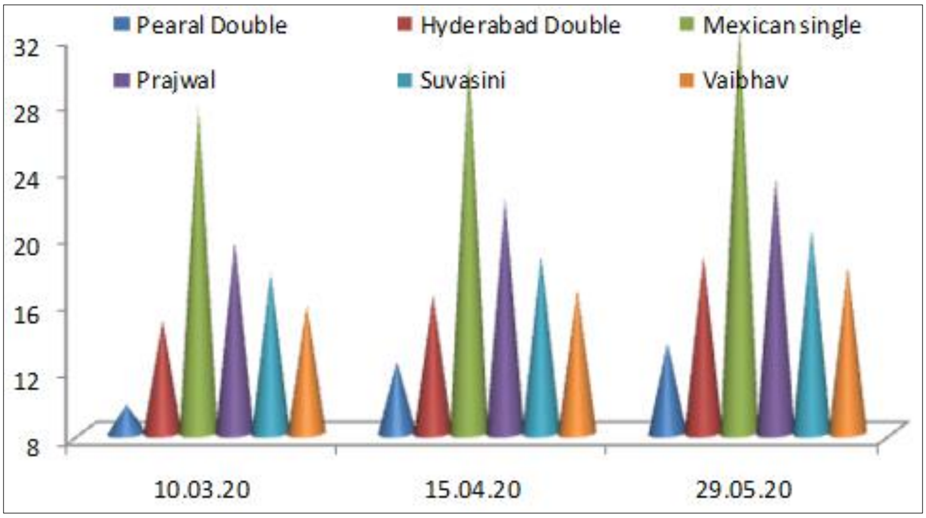


Fig 1: Variation among genotypes for Number of bulbs (2019 & 2020)

Table 2: Three factor analysis for Number of bulbs

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	11.13	11.84	9.30	11.97	13.20	11.49
Hyderabad Double	16.00	16.60	14.47	16.13	18.30	16.30
Mexican single	25.91	30.20	25.63	28.00	30.53	28.06
Prajwal	20.76	21.69	19.17	21.60	22.90	21.22
Suvasini	18.36	18.91	17.30	18.53	20.07	18.63
Vaibhav	15.80	16.82	15.17	16.03	17.73	16.31

	17.99	19.34	16.84	18.71	20.46	
CD at 5% for genotypes	0.53	0.57				0.3773
CD at 5% for dates						0.2668
CD at 5% for years						0.2178

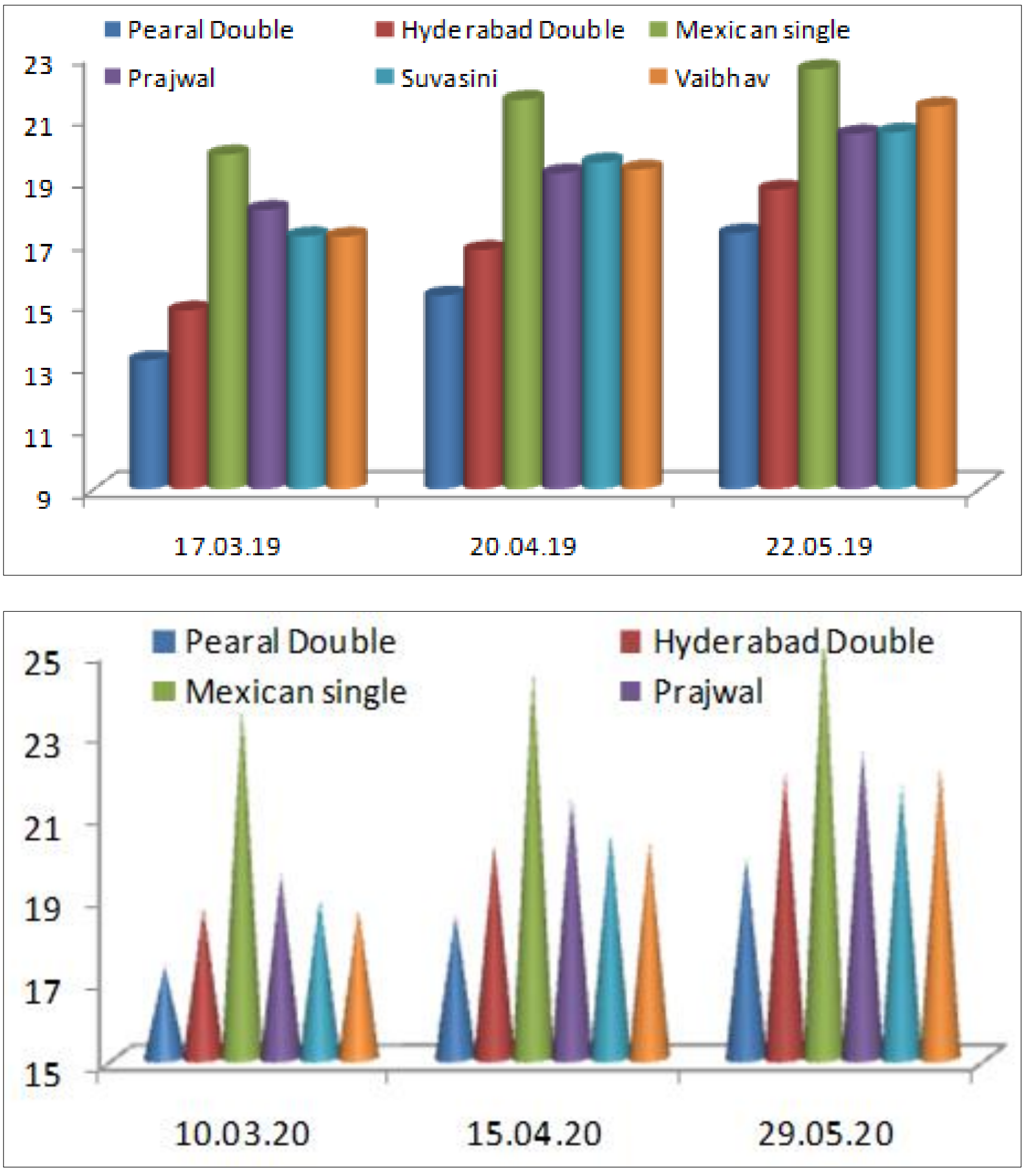


Fig 2: Variation among genotypes for bulb Diameter (2019 & 2020)

Table 3: Three factor analysis for bulb Diameter

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	15.22	18.54	15.20	16.87	18.56	16.88
Hyderabad Double	16.71	20.31	16.73	18.47	20.34	18.51
Mexican single	21.31	24.58	21.69	23.01	24.12	22.94
Prajwal	19.22	21.13	18.75	20.28	21.50	20.18
Suvasini	19.07	20.35	18.02	20.03	21.09	19.71
Vaibhav	19.27	20.36	17.89	19.81	21.74	19.81
	18.47	20.88	18.05	19.75	21.23	
CD at 5% for genotypes	0.73	0.56				0.448
CD at 5% for dates						0.3168
CD at 5% for years						0.2587

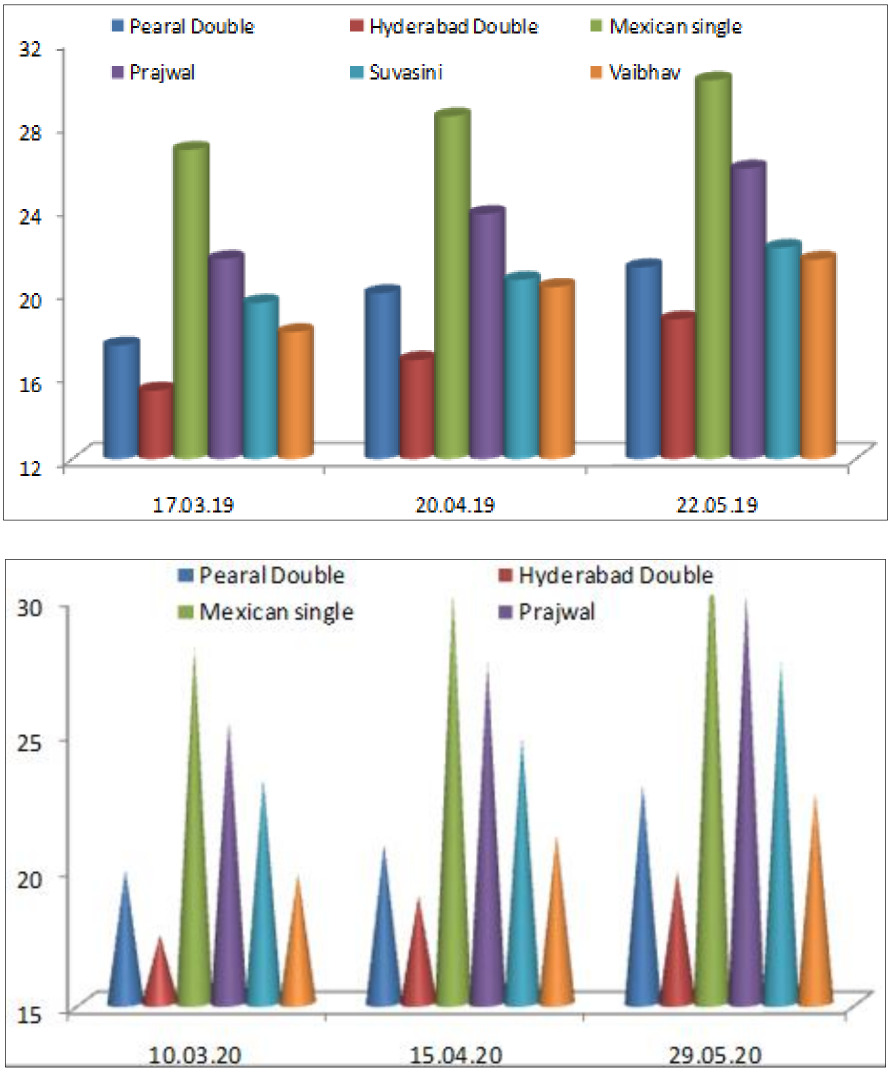
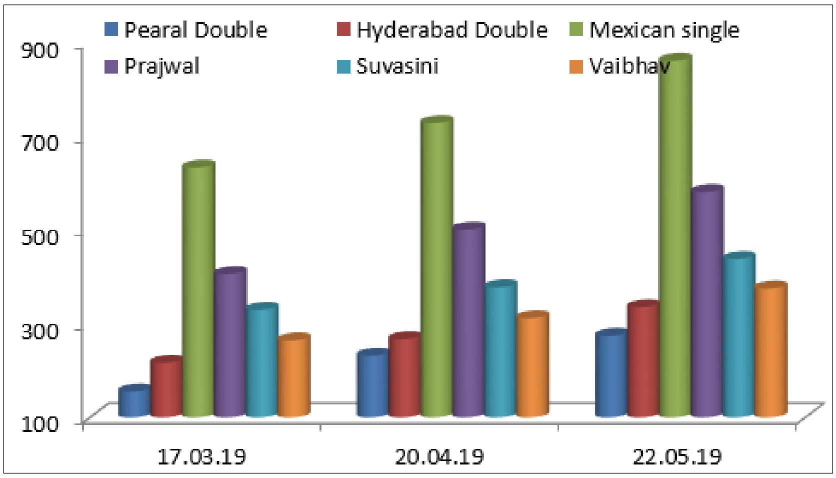


Fig 3: Variation among genotypes for bulb Weight (2019 & 2020)

Table 4: Three factor analysis for bulb Weight

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	19.51	21.24	18.67	20.38	22.08	20.38
Hyderabad Double	16.89	18.77	16.38	17.85	19.25	17.83
Mexican single	28.44	30.10	27.45	29.25	31.11	29.27
Prajwal	23.73	27.63	23.47	25.62	27.97	25.68
Suvasini	20.71	25.19	21.35	22.68	24.82	22.95
Vaibhav	19.94	21.23	18.92	20.72	22.13	20.59
	21.54	24.03	21.04	22.75	24.56	
CD at 5% for genotypes	0.66	0.54				0.4138
CD at 5% for dates						0.2926
CD at 5% for years						0.2389



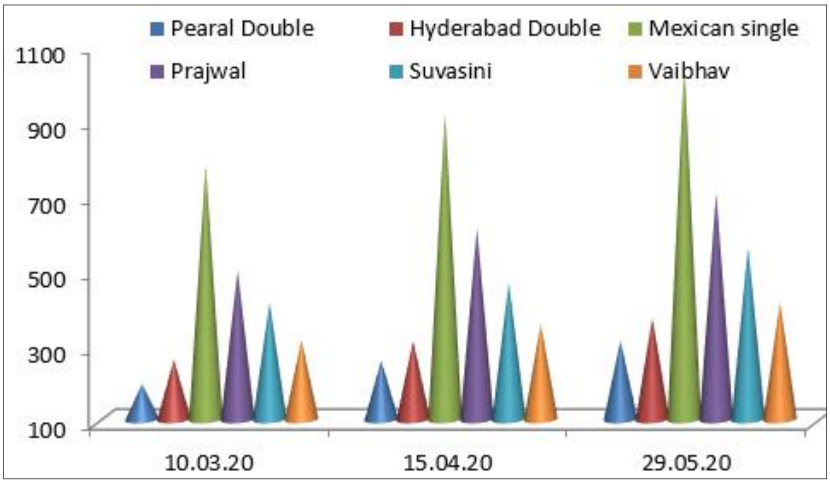
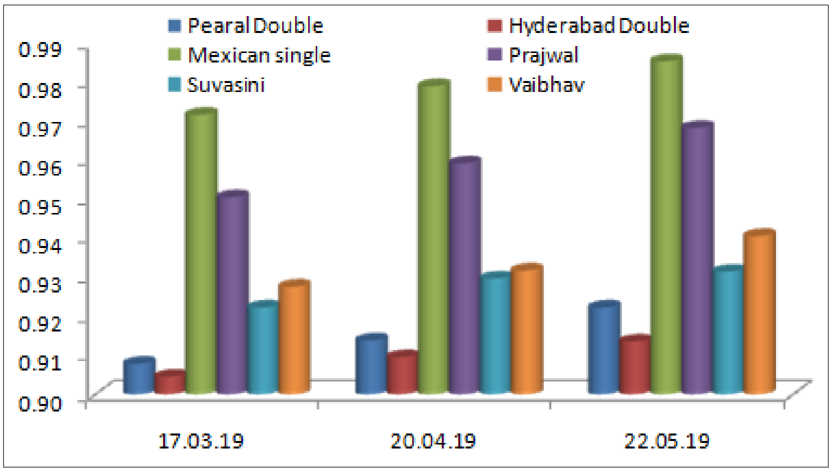


Fig 4: Variation among genotypes for bulbs yield per clump (2019 & 2020)

Table 5: Three factor analysis for bulbs yield per clump

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	Combined Mean
Pearl Double	219.96	253.50	174.46	244.07	291.66	236.73
Hyderabad Double	272.64	313.04	237.76	288.21	352.54	292.84
Mexican single	739.88	912.33	704.71	821.38	952.24	826.11
Prajwal	495.26	602.51	450.72	554.50	641.44	548.89
Suvasini	381.32	478.22	369.88	420.83	498.60	429.77
Vaibhav	316.64	358.24	287.32	332.23	392.78	337.44
	404.28	486.31	370.81	443.54	521.54	
CD at 5% for genotypes	17.67	18.66				12.55145
CD at 5% for dates						8.8752
CD at 5% for years						7.2466



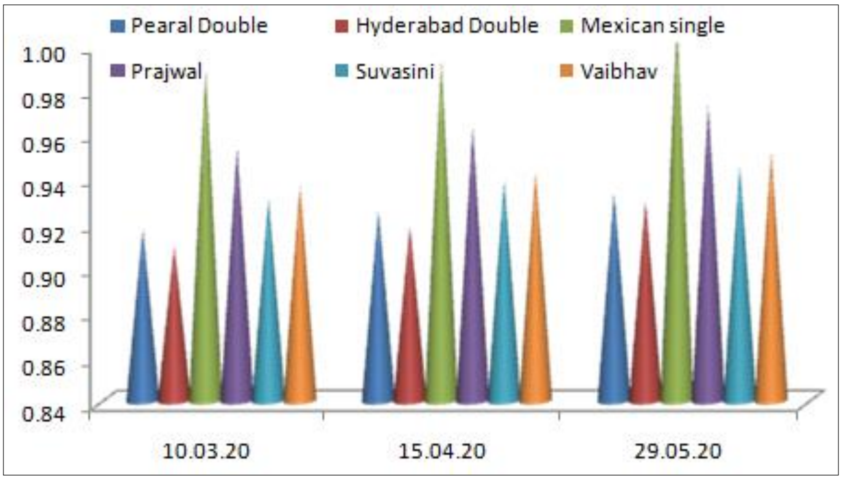


Fig 5: Variation among genotypes for Specific Gravity (2019 & 2020)

Table 6: Three factor analysis for Specific Gravity

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	0.91	0.92	0.91	0.92	0.93	0.92
Hyderabad Double	0.91	0.92	0.91	0.91	0.92	0.91
Mexican single	0.98	1.00	0.98	0.99	1.00	0.99
Prajwal	0.96	0.96	0.95	0.96	0.97	0.96
Suvasini	0.93	0.94	0.93	0.93	0.94	0.93
Vaibhav	0.93	0.94	0.93	0.94	0.95	0.94
	0.94	0.95	0.93	0.94	0.95	
CD at 5% for genotypes	0.00	0.00				0.0009
CD at 5% for dates						0.0006
CD at 5% for years						0.0005

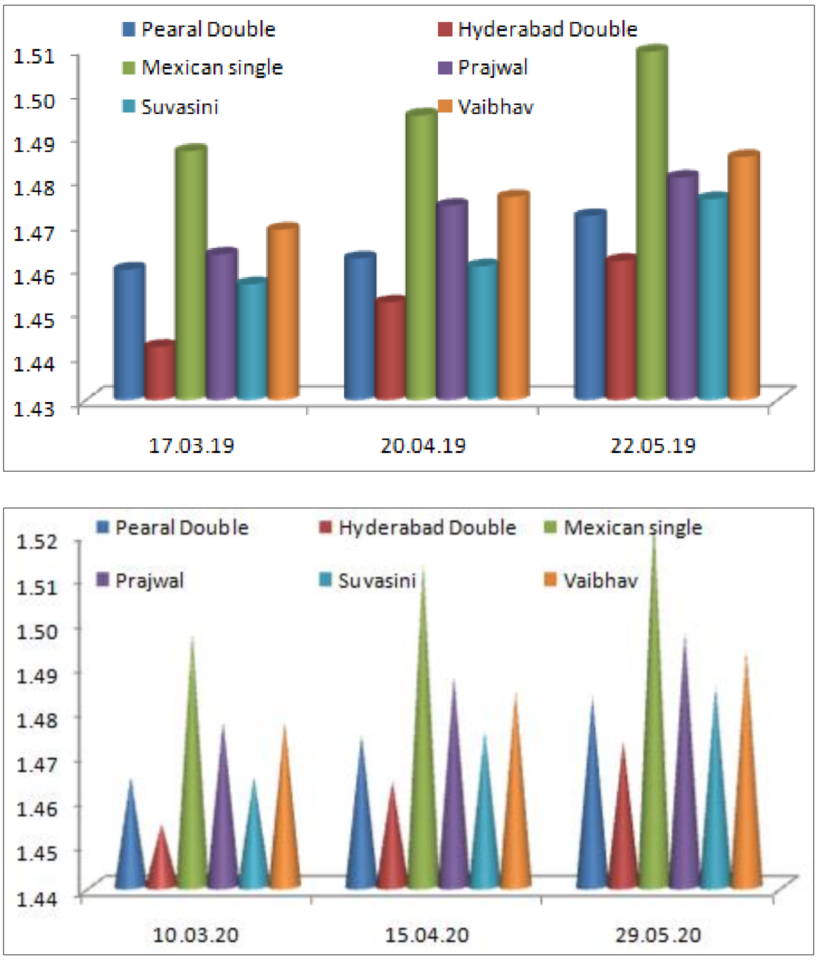
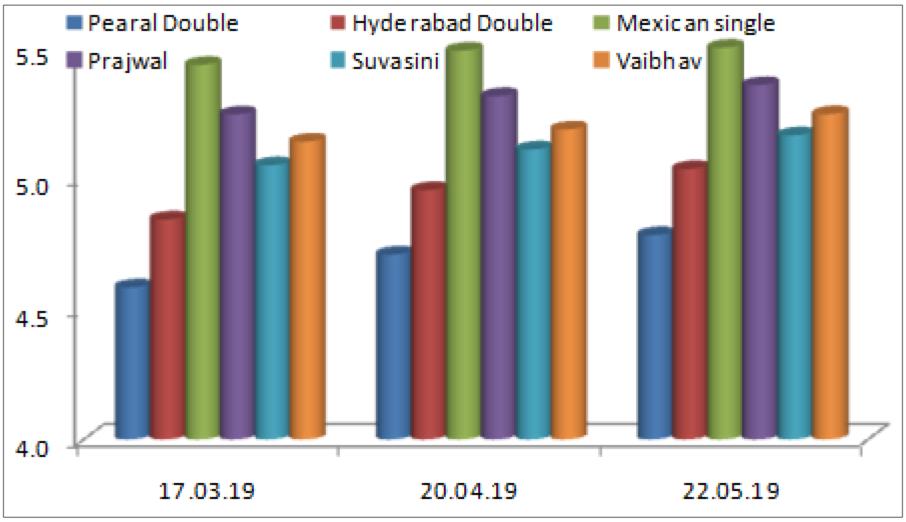


Fig 6: Variation among genotypes for Refractive Index (2019 & 2020)

Table 7: Three factor analysis for Refractive Index

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	1.4646	1.4739	1.4621	1.4682	1.4773	1.4692
Hyderabad Double	1.4520	1.4635	1.4480	1.4579	1.4672	1.4577
Mexican single	1.4969	1.5111	1.4919	1.5038	1.5162	1.5040
Prajwal	1.4727	1.4871	1.4701	1.4807	1.4889	1.4799
Suvasini	1.4642	1.4749	1.4604	1.4677	1.4804	1.4695
Vaibhav	1.4768	1.4847	1.4729	1.4801	1.4891	1.4807
	1.4712	1.482	1.4676	1.4764	1.4865	
CD at 5% for genotypes	0.0014	0.0044				0.0012
CD at 5% for dates						0.0009
CD at 5% for years						0.0007



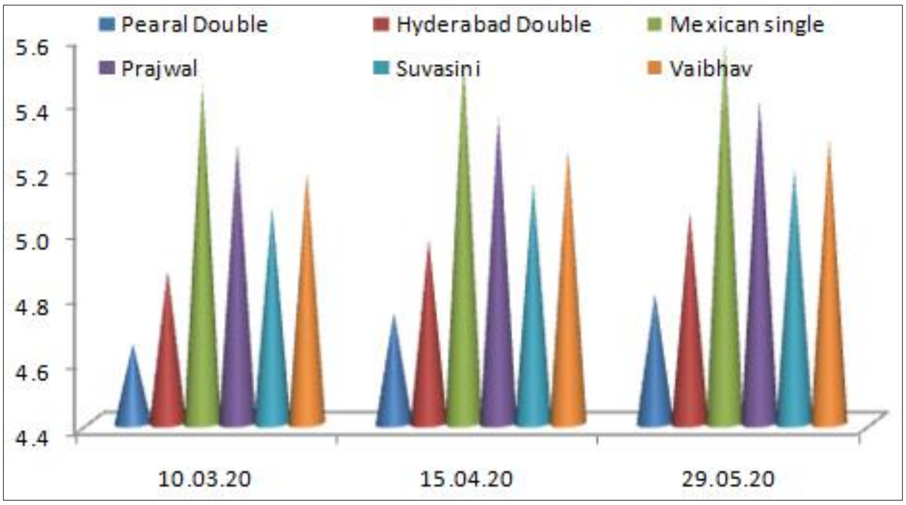


Fig 7: Variation among genotypes for pH of oil (2019 & 2020)

Table 8: Three factor analysis for pH of oil

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	4.69	4.73	4.61	4.72	4.79	4.71
Hyderabad Double	4.94	4.96	4.86	4.96	5.04	4.95
Mexican single	5.49	5.52	5.44	5.50	5.56	5.50
Prajwal	5.31	5.34	5.25	5.33	5.38	5.32
Suvasini	5.11	5.13	5.06	5.13	5.17	5.12
Vaibhav	5.19	5.23	5.16	5.22	5.27	5.21
	5.12	5.15	5.06	5.14	5.20	
CD at 5% for genotypes	0.02	0.01				0.0107
CD at 5% for dates						0.0075
CD at 5% for years						0.0062

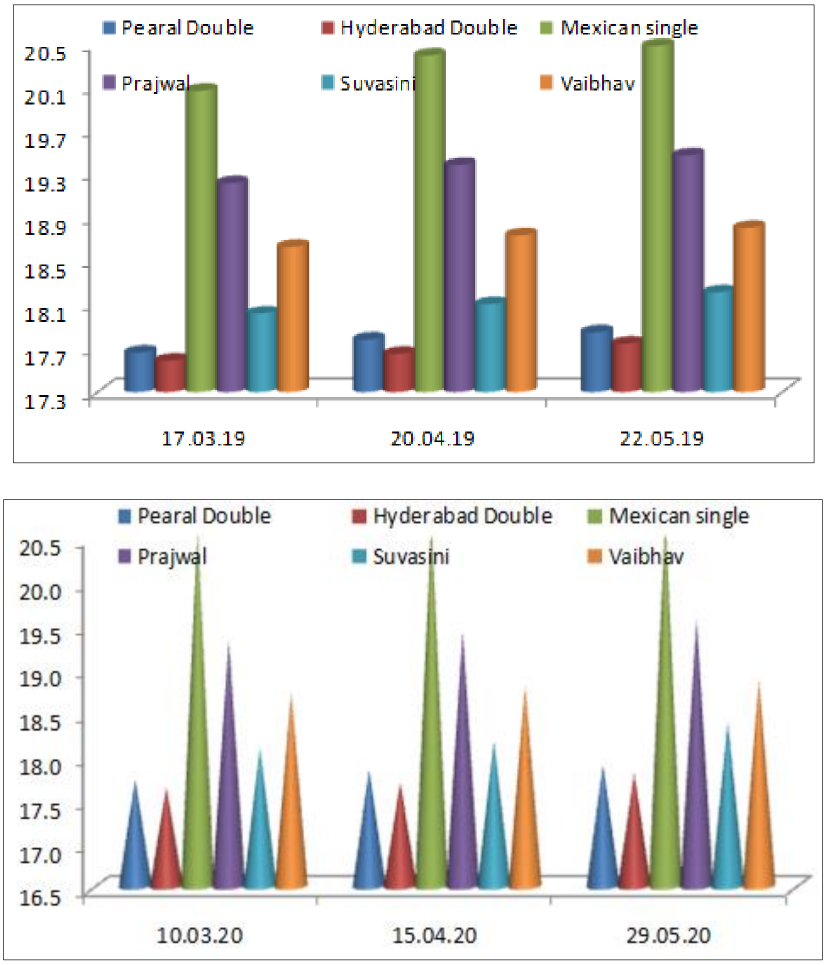
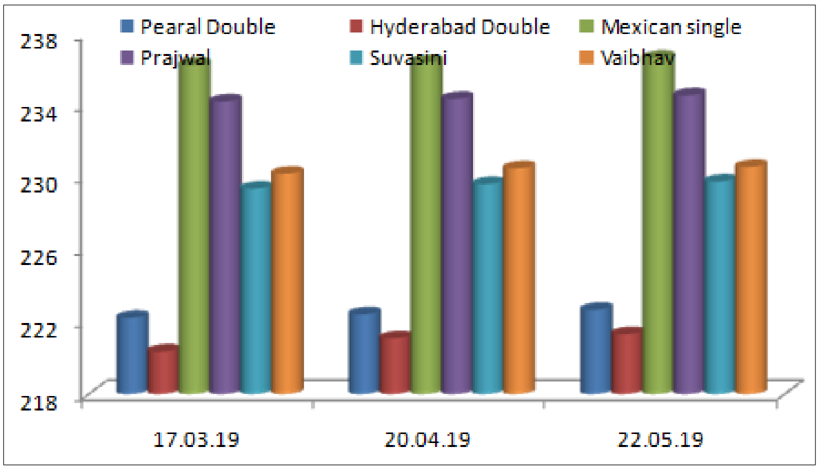


Fig 8: Variation among genotypes for Acid value (2019 & 2020)

Table 9: Three factor analysis for Acid value

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	Combined Mean
Pearl Double	17.77	17.82	17.69	17.81	17.87	17.79
Hyderabad Double	17.66	17.71	17.61	17.67	17.77	17.69
Mexican single	20.32	20.66	20.33	20.53	20.62	20.49
Prajwal	19.37	19.43	19.27	19.41	19.52	19.40
Suvasini	18.12	18.21	18.06	18.14	18.30	18.16
Vaibhav	18.73	18.79	18.67	18.77	18.84	18.76
	18.66	18.77	18.60	18.72	18.82	
CD at 5% for genotypes	0.02	0.02				0.0144
CD at 5% for dates						0.0102
CD at 5% for years						0.0083



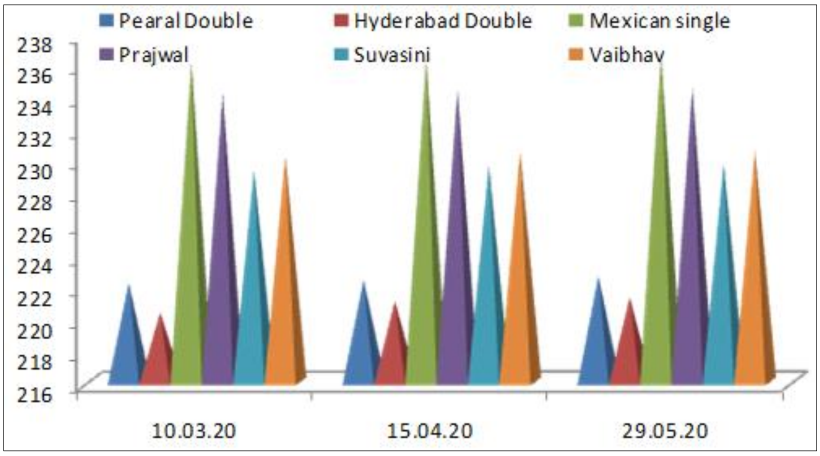


Fig 9: Variation among genotypes for Easter value (2019 & 2020)

Table 10: Three factor analysis for Easter Value

Dates/Genotypes	2019	2020	Date1	Date 2	Date 3	Combined Mean
Pearl Double	222.44	222.44	222.23	222.42	222.67	222.44
Hyderabad Double	220.92	220.92	220.36	221.09	221.32	220.92
Mexican single	236.45	236.45	236.27	236.41	236.67	236.45
Prajwal	234.40	234.40	234.24	234.39	234.59	234.40
Suvasini	229.62	229.62	229.40	229.65	229.80	229.62
Vaibhav	230.46	230.46	230.23	230.53	230.61	230.46
			228.79	229.08	229.28	
CD at 5% for genotypes	0.04	0.04				0.0246
CD at 5% for dates						0.0174
CD at 5% for years						0.0142

Conclusions

Staggered planting of tuberose to mitigate the vagaries of temperature, humidity and rainfall ensure continuous harvest the good crop. Uninterrupted supply will help to provide regular income to growers, employment to youth and increased availability of flowers to the markets for flowers and oil based products.

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