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Staggered Sowing of Genotypes affect Growth Traits of Tuberose (*Polianthes tuberosa* L.)

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ABSTRACT: Six promising genotypes were evaluated for growth traits at three dates of sowings at CCS Haryana Agricultural University, Hisar during 2019 and 2020 cropping seasons. Highly significant variations due to genotypes, dates of sowing and years had been observed by analysis of variance. May sowing would be preferable as all genotypes took least days for sprouting. Maximum increase height seen for Suvasini followed by Prajwal while least increase for Pearl double in the combined analysis. Number of leaves per clump of tuberose was significantly affected by dates of sowing as more number of leaves per clump gained by all genotypes by switching from March to May. Large values of leaf length exhibited by Mexican single followed by Suvasini while least leaf length by Pearl Double in the combined analysis. Mexican single also expressed least change in lengths value in combined analysis of genotypes. The staggering planting enables a continuous supply of cut flowers to the markets over an extended period and avoid glut in the market to safeguard farmers from distressed sale of produce.

Keywords: *Polianthes tuberose*, sprouting, leaves, length, width.

INTRODUCTION

Tuberose (*Polianthes tuberosa* L.), native of Mexico, is an important bulbous ornamental plant which is cultivated on the large area in India for loose flowers as well as cut flowers (Kumar *et al.,* 2021). Mostly tuberose is used for cut flower owing long vase life along with attractive spikes, and as loose flower for making gajra, veni, bracelets, buttonhole, garlands (Khan *et al.,* 2020). Flowers have been utilized to extract natural high valued oil as rich in benzyl alcohol, eugenol, benzyl benzoate and methyl anthranilate. Due to these compounds flower oil has medicinal and aromatic properties and purposefully used in perfumes, cosmetics, soaps and other products (Madhumathi *et al.,* 2018). The scent of tuberose is able to relieve the stress; hence it urges the healing process using aromatherapy (Qureshi *et al.,* 2018). The export trade of essential oils and perfumes has been increased over the decade. To ensure continuous supply of flowers, staggered planting time has been recognized as an important planting strategy (Ali *et al.,* 2019). The climatic factors like temperature, humidity and rainfall has expressed vagaries over the time and these would be exploited for successful tuberose production (Dogra *et al.,* 2020). The staggered planting dates ensure a continuous supply of cut flowers over an extended period of harvest and which can avoid glut in the market (Zamin *et al.,* 2020). Staggered planting time provide continuous flower, regular income to growers, employment and increased flower duration (Meena *et al.,* 2018). Not so much of research work had been undertaken on staggering sowing of tuberose. The present investigation was planned to study the effect of staggered sowing dates on growth traits of tuberose.

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. Hisar station is situated in the subtropics at an altitude of 215.2 meter above mean sea level with North latitude 29º10′ and East longitude 75º46′. Experiment 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 growth characters. Plant to plant spacing of 30 cm × 30cm was maintained in net plot size of 1.5m × 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 growth traits viz., days to initial sprouting, days to complete sprouting, plant height (cm), number of leaves per plant, leaves length, leaves width. Reputed statistical software SAS version 9.3 along with JMP 9 was exploited for analysis and graphical presentations.

RESULTS AND DISCUSSION

Highly significant variations due to genotypes, dates of sowing and years of study had been observed by analysis of variance as tabulated in Table 1 (Jadhav *et al.,* 2020). First order and second order interactions were also significant at 5% level of significance for most of the traits.

Table 1: Significance level for Mean Square Error of growth traits.

Source	df	Days taken to initiation of sprouting	Days taken to complete sprouting	Plant height (cm)	Number of leaves per clump	Leaf length (cm)	Leaf width (cm)
Genotypes (G)	5	218.3***	124.66***	3547.3***	1549.1***	713.94***	0.61***
Date of sowing (D)	2	634.44***	1396.30***	320.79***	669.27***	277.94***	0.29***
Year (Y)	1	281.62	263.83	1153.13	12692.34	639.97	0.28
G × D interaction	10	3.96***	5.03***	0.95*	43.89***	5.33***	0.020***
G × Y interaction	2	15.00	16.91	99.21	732.27	18.82	0.039
G × D × Y interaction	10	1.36**	3.89***	0.80 ns	75.76***	1.18**	0.002***
Error	70	0.49	0.77	0.46	1.06	0.45	0.0003

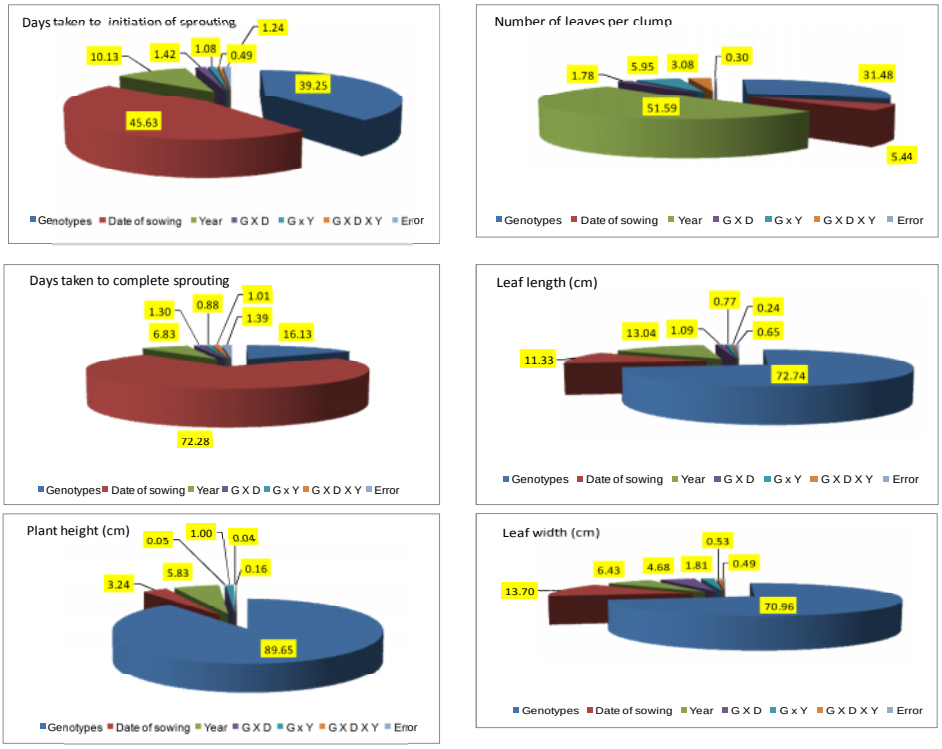

Fig. 1. Percentage share of genotypes, dates and year effects to total sum of squares of growth traits.

A. Days to sprouting initiation

Table 2 presented the differences among genotypes over the dates of sowing. Earliness in flowering is an important character, which helps farmers to fetch early market. All genotypes achieved maximum values for days for initial sprouting for March sown and Mexican single has expressed maximum days at March sowing as compared to May sowing in the first year of study (Ahmad *et al.*, 2019). May sowing would be preferable as genotypes took least days for sprouting. Same behavior of genotypes vs-a-vis dates of sowing expressed during second year of study. Hyderabad double took least days in both years for sprouting initiation. However April end sowing would be beneficial for farmers cultivating Tubersome. Major effects Genotypes, dates of sowing and year accounted for 39.25%, 45.63%, 10.13% of total sum of squares respectively. Combined analysis of data sets also pointing towards Hyderabad double followed by Suvasini.

Table 2: Three factor analysis for days taken to initiation of sprouting.

Dates/Genotypes	Year 1	Year 2	Date 1	Date 2	Date 3	Combined Mean
Pearl Double	24.22	19.40	25.93	21.77	17.73	21.81
Hyderabad Double	21.40	18.36	23.27	19.93	16.43	19.88
Mexican single	30.51	27.07	33.80	29.33	23.23	28.79
Prajwal	27.02	25.69	31.23	26.17	21.67	26.36
Suvasini	22.49	18.67	24.03	20.33	17.37	20.58
Vaibhav	24.98	22.07	27.57	23.97	19.03	23.52
	25.10	21.87	27.64	23.58	19.24	
CD at 5% for genotypes	0.77	0.58				0.4658
CD at 5% for dates						0.3293
CD at 5% for years						0.2689

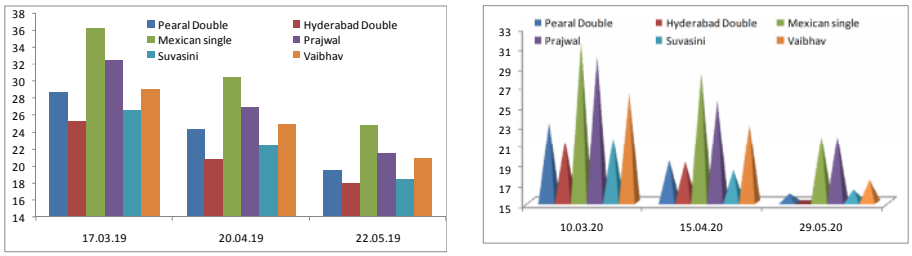

Fig. 2. Difference among genotypes for dates of sowing for initiation of sprouting.

B. Days to complete sprouting

The data concerning to days taken to complete sprouting in Table 3 show that different genotypes showed contrasting variation from March to May sowing during first year as maximum days required by Prajwal followed by Mexican single. Nearly eleven days advantage observed for May sowing as Pearl double (34 to 24), Hyderabad double (36 to 23), Mexican single (41 to 26), Prajwal (42 to 29), Suvasini (38 to 26) and Vaibhav (40 to 26) reduced to less days for sprouting. Similarly days taken to sprouting had reduced further during evaluation of genotypes during 2020. As Mexican single took 40 to 26 days for sprouting while Suvasini took only 34 to 19 days. Combined analysis had expressed least days for Hyderabad double followed by Pearl double. Maximum days required for Prajwal sprouting. Major effects Genotypes, dates of sowing and year accounted for 16.13%, 72.28%, 6.83% of total sum of squares respectively.

Table 3: Three factor analysis for days taken to complete sprouting.

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	Combined Mean
Pearl Double	30.11	25.76	33.30	28.27	22.23	27.93
Hyderabad Double	29.73	25.80	33.77	27.47	22.07	27.77
Mexican single	33.36	32.38	40.37	33.10	25.13	32.87
Prajwal	35.64	32.69	40.80	33.63	28.07	34.17
Suvasini	32.22	28.38	35.60	30.33	24.97	30.30
Vaibhav	33.31	30.62	38.40	32.47	25.03	31.97
	32.40	29.27	37.04	30.88	24.58	
CD at 5% for genotypes	1.04	0.51				0.5819
CD at 5% for dates						0.4115
CD at 5% for years						0.336

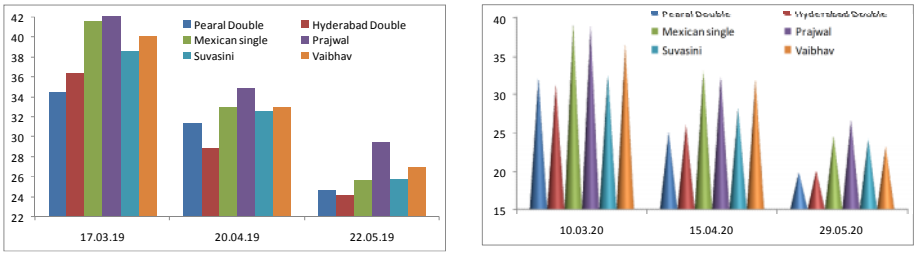

Fig. 3. Difference among genotypes for dates of sowing for complete sprouting.

C. Plant height of genotypes

Plant growth which is considered to be a good index of plant vigor also contributes towards greater productivity. The data presented in Table 4 clearly indicate that plant height has shown as increasing trends for all genotypes with augmentation of dates of sowing (Bharathi *et al.*, 2019). Larger plants were observed for May sowing as compared to March in first year as height increased from 40 to 45 days for Pearl double and 76 to 84 for Prajwal. Delaying sowing has increased the height in the second year also as 46 to 55 for Pearl double, 60 to 66 for Hyderabad double and maximum of five days for Mexican single and Suvasini both. Maximum height increased for Suvasini followed by Prajwal while least increase for Pearl double in combined analysis of data sets for both years of study. Major effects of genotypes, dates of sowing and years accounted for 89.65%, 3.24%, 5.83 % of total sum of squares respectively.

Table 4: Three factor analysis for plant height.

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	combined
Pearl Double	43.20	48.99	42.82	46.13	49.33	46.09
Hyderabad Double	54.13	61.64	55.23	57.80	60.63	57.89
Mexican single	74.80	82.49	75.53	78.60	81.80	78.64
Prajwal	78.47	79.67	75.63	79.17	82.40	79.07
Suvasini	76.11	83.04	77.07	79.70	81.97	79.58
Vaibhav	69.58	79.67	71.87	74.17	77.83	74.62
	66.05	72.58	66.36	69.26	72.33	
CD at 5% for genotypes	0.67	0.61				0.4521
CD at 5% for dates						0.3197
CD at 5% for years						0.261

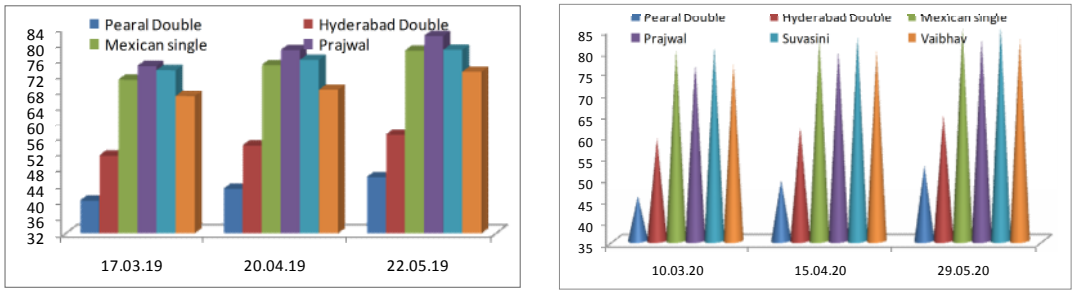

Fig. 4. Difference among genotypes for dates of sowing for plant height.

D. Leaves per clump

The variation in number of leaves per plant amongst the varieties might be due to variation amount of stored food material in mother corms expressed by their sizes. It could also be due to variation in rate of vegetative growth among the genotypes that could be attributed to their genetic makeup and could have been further influenced by the agro-climatic conditions. Number of leaves per clump of tuberose was significantly affected by dates of sowing as more number of leaves per clump gained by all genotypes by switching from March to May in the first year (Naik *et al.*, 2018). The maximum number of leaves per clump 52 was observed for Mexican single followed by 45 for Suvasini accompanied with least per clump 28 for Pearl double. Moreover increase of number of leaves per clump varied as 7, 6, 9, 8, 4, 5 exhibited by Pearl double, Hyderabad double, Mexican single, Prajwal, Suvasini and Vaibhav respectively. Similar trends of increase maintained by genotypes during second year of study also as May sowing expressed maximum number of leaves per clump for all genotypes. Increase from 39 to 46 by Hyderabad double and large increase from 45 to 74 by Suvasini genotype. The effects of genotypes, dates of sowing and years were substantial and accounted for 31.48%, 5.44%, 51.59% of total sum of squares respectively. Combined analysis had seen maximum number of leaves for Mexican single followed by Suvasini whereas least number of leaves for Hyderabad Double tuberose genotype.

Table 5: Three factor analysis for number of leaves per clump.

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	combined
Pearl Double	24.58	53.98	36.47	39.30	42.07	39.28
Hyderabad Double	32.00	40.51	33.00	36.40	39.37	36.26
Mexican single	47.49	75.76	58.37	61.27	65.23	61.62
Prajwal	35.71	61.53	45.10	49.07	51.70	48.62
Suvasini	42.13	64.18	42.47	55.73	61.27	53.16
Vaibhav	37.58	53.62	42.23	44.97	49.60	45.60
	36.58	58.26	42.94	47.79	51.54	
CD at 5% for genotypes	0.75	1.16				0.6852
CD at 5% for dates	0.53	0.82				0.4845
CD at 5% for years						0.3956

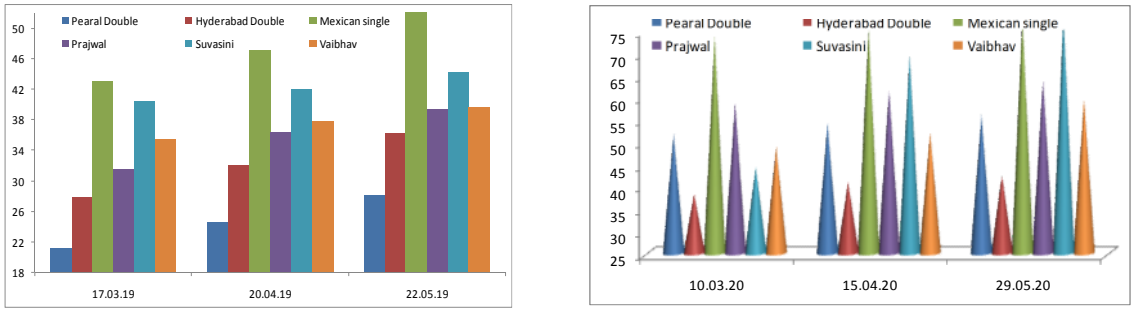

Fig. 5. Difference among genotypes for dates of sowing for number of leaves per clump.

E. Leaf length of genotypes

The data regarding the leaves length of genotypes during 2019 and 2020 have been presented in Table 6. The leaves length increased significantly with advancing date of sowing as maximum length observed for Mexican single, followed by Suvasini and least increased maintained by Pearl double for the first year (Rosalind *et al.*, 2018). Increased from 25 to 32, 29 to 34, 42 to 46, 30 to 37, 40 to 44 and 34 to 41 by respective genotypes as maximum increase accounted by Vaibhav. Consistent augmentation in leaf length observed for all genotypes in the second year as 30 to 35 expressed by Pearl double and maximum of 40 to 49 by Vaibhav. The effects of genotypes, dates of sowing and year had accounted for 72.74%, 11.33%, 13.04% of total sum of squares respectively. Large values of leaf length exhibited by Mexican single followed by Suvasini while least leaf length by Pearl Double in the combined analysis. Least change in lengths expressed by Mexican single genotypes in combined analysis of genotypes.

Table 6: Three factor analysis for leaf length.

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	Combined Mean
Pearl Double	27.92	30.99	26.98	29.52	31.87	29.46
Hyderabad Double	31.38	37.54	31.65	34.05	37.68	34.46
Mexican single	44.06	47.98	44.07	45.93	48.05	46.02
Prajwal	32.91	38.19	32.02	35.18	39.45	35.55
Suvasini	41.62	46.06	42.18	43.88	45.45	43.84
Vaibhav	37.89	44.23	37.05	41.35	44.78	41.06
	35.96	40.83	35.66	38.32	41.21	
CD at 5% for genotypes	0.71	0.56				0.448
CD at 5% for dates	0.50	0.39				0.3168
CD at 5% for years						0.2587

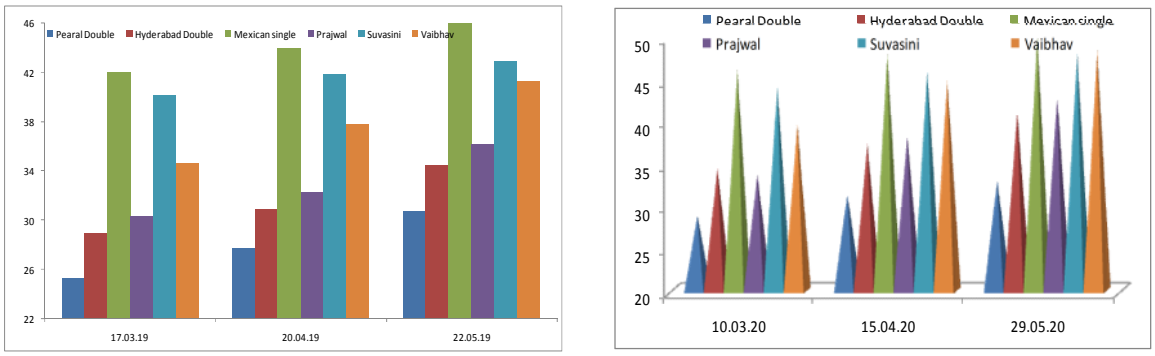

Fig. 6. Difference among genotypes for dates of sowing for leaf length.

F. Leaf width

Studied genotypes also expressed increased Leaf width from March to May sowing for the first year even the least increase would help in better photosynthesis activities in turn aid to increase the yield. Marginal increase has observed for all genotypes irrespective of dates of sowing. May sowing would be more economical for tuberose cultivation. Similar behavior of genotypes had maintained in the second year also as maximum advantage showed by Vaibhav followed by Suvasini. Large values of leaf width expressed by Prajwal followed by Major effects Genotypes, dates of sowing and year accounted for 70.96%, 13.70%, 6.43% of total sum of squares respectively. Mexican single besides least values by Hyderabad Double for the combined three way of analysis as year was also considered as a factor apart from genotypes and dates of sowing.

Table 7: Three factor analysis for leaf width.

Dates/Genotypes	2019	2020	Date 1	Date 2	Date 3	Combined Mean
Pearl Double	0.933	1.064	0.94	1.00	1.06	1.00
Hyderabad Double	0.761	0.833	0.75	0.78	0.86	0.80
Mexican single	1.155	1.364	1.19	1.27	1.32	1.26
Prajwal	1.270	1.339	1.24	1.32	1.36	1.30
Suvasini	1.094	1.146	0.91	1.14	1.31	1.12
Vaibhav	1.023	1.099	0.96	1.05	1.18	1.06
	1.039	1.141	1.00	1.09	1.18	
CD at 5% for genotypes	0.012	0.021				0.0116
CD at 5% for dates						0.0082
CD at 5% for years						0.0067

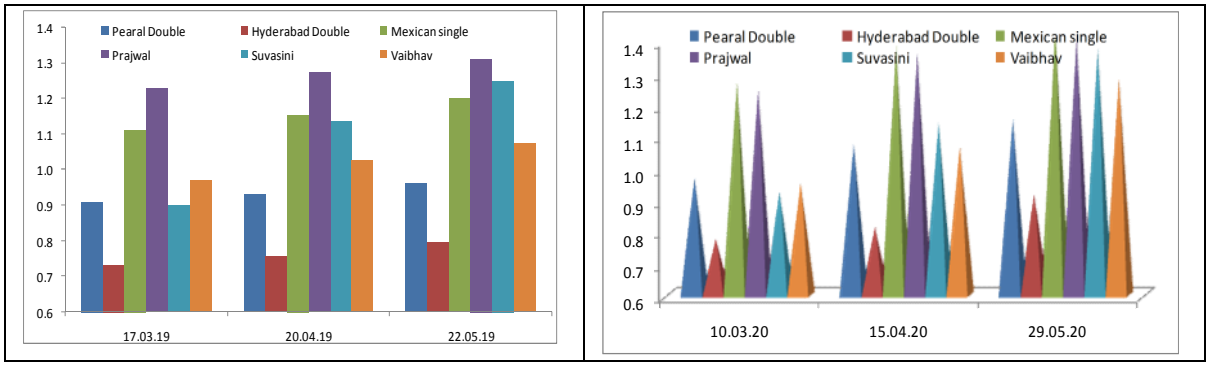

Fig. 7. Difference among genotypes for dates of sowing for leaf width.

CONCLUSION

Staggered planting has been established as important strategy to ensure continuous supply of quality flowers to the market. The climatic factors like temperature, humidity and rainfall had been expressed vagaries over the different times of sowing of tuberose in the fields. The planned staggering planting over different dates enables a continuous supply of cut flowers over an extended period of harvest and at the same time aid to avoid glut in the market. This strategy would provide regular income to growers, employment to youth and increased availability of flowers to the users.

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Conflict of Interests. None.

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