



Effect of land configuration and integrated nutrient management on growth, quality and yield of tuberose (*Polianthes tuberosa*) var. Prajwal

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ABSTRACT

Present investigation was carried out to standardize the land configuration and nutrients for better quality and yield of tuberose (*Polianthes tuberosa* L) spikes on heavy black soil of Navsari (Gujarat) during 2011-12 to 2013-14. The experiment was laid out in split-plot design having four levels of land configuration (main plot) and three levels of nutrients (sub plot). The results indicated that planting of tuberose bulbs in 3 rows on raised bed (90 cm width) recorded significantly early sprouting (21.73 days) with maximum sprouting percentage (98.28), plant height (65.10 cm), leaves/plant (76.79), leaf area (105.24 cm²), florets/spike (43.52), rachis length (32.38 cm), spike length (102.46 cm), spike duration (16.00 days), vase life (13.55 days), spikes/plant (2.45), spikes/ha (188850.31), bulbs/plant (13.09), bulbs/ha (1030790) and bulblets/plant (29.11). In nutrient management, application of fertilizer dose (300:200:100 NPK kg/ha/year) along with FYM @ 15 t/ha/year recorded early sprouting (23.15 days) with maximum sprouting percentage (96.04), plant height (63.44 cm), leaves/plant (71.16), leaf area (99.56 cm²), florets/spike (39.93), rachis length (30.99 cm), spike length (97.94 cm), spike duration (14.18 days) and vase life (12.07 days), spikes/plant (2.23), spikes/ha (195577.74), bulbs/plant (10.63), bulbs/ha (928560.00) and bulblets/plant (28.83). Raised bed planting had favourable effect on growth and yield of tuberose as compared to ridge and furrow and flat bed planting.

Key words: Growth, INM, Land configuration, Tuberose, Yield

Tuberose (*Polianthes tuberosa* L.) is also known as *rajnigandha*, *gul-e-chari*, *nishighandha* and *sem pangi* which is native of Mexico and belongs to the family Amaryllidaceae. It is one of the most important bulbous plants of tropical and sub-tropical areas because of attractive waxy, white, fragrant single and double type florets.

It is used not only as cut flower, loose flower for making garlands bracelets, *veni* but also used for extraction of valuable essential oil from highly fragrant florets. Tuberose flowers during summer, rainy and autumn seasons. Thus, it becomes very important cut flower of rainy and summer seasons of India during scarcity of cut flowers in markets.

Generally, tuberose is grown on different types of soils but it thrives better in a well drained loamy soil. It is gaining attention of farmers of south Gujarat due to assured quality water availability of canal at cheap rate, nearby big markets and better transport facilities. Though, its productivity and quality are constrained by soil physical and hydrological properties due to high proportion of clay content (40-

60%). Majority of the soils of south Gujarat falls under Vertic Ustochrepts characterized by low infiltration, poor internal drainage, narrow workable moisture range, variable moisture availability, loss of soil structure, low organic matter, high cation exchange capacity and alkaline reaction which adversely affect development of bulbs resulting poor vegetative growth, quality and yield.

This can partially be overcome by various land management system involving raised beds of different widths, ridge and furrow and management of nutrients through integrated approaches. They play an important role in enhancing the productivity and improving the quality of tuberose flowers through improving soil-water-nutrient-plant relationship. No systematic work has been carried out on these aspects in tuberose in Gujarat, therefore, present experiment was planned to evaluate the effect of both with different levels on growth and flowering of tuberose var. Prajwal.

MATERIALS AND METHODS

A field experiment was carried out at Floriculture Research Farm, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari during 2011-12 to 2013-14. The experiment was conducted in split plot design where the main plot was land configuration having four levels, viz. flat bed (L₁, farmers practice), ridge and furrow (L₂), raised bed of 90 cm width with 3 rows (L₃)

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and raised bed of 120 cm width with 4 rows (L_4) of bulb planting; sub plot was nutrient management in different ways having three levels, viz. fertilizer dose alone (I_1 , 300-200-100 kg/ha N-P₂O₅-K₂O), fertilizer dose along with FYM @ 15 t/ha/year (I_2) and fertilizer dose along with sugarcane bio-compost @ 10 t/ha/year (I_3). These 12 treatment combinations were replicated thrice. Bulbs of variety Prajwal having 3-3.5 cm diameter were used for experiment and planted in April, 2011.

In flat bed or plot (farmers practice), bulbs were planted at 40×30 cm distance (L_1).

In ridge and furrow method, ridges of 50 cm were prepared after leaving 30 cm distance between two ridges and two lines of bulb at 30×30 cm distance were planted on a ridge after leaving 10 cm from both sides of ridge (L_2). Raised beds of 15 cm height were prepared and bulbs were planted at 30×30 cm distance. Raised beds (90 cm wide) with 3 lines of bulbs planting and 30 cm gap among two beds in L_3 ; raised beds of 120 cm wide accommodating 3 lines of bulbs having 40 cm gap among two beds in L_4 . raised beds were repaired in October (after rainy season) and April manually to provide them proper shape every year.

Nitrogen was applied in four equal split doses every year (3 months interval), while, full amount of phosphorus, potash, sugarcane compost and FYM were applied once in a year during April. The required quantity of sugarcane pressmud based bio-compost and well decomposed FYM were applied as per treatment thoroughly mixed in the soil before planting in first year, while, these were applied after hoeing and before bed repairing in April month for next two years of ratoon crop.

Five plants were randomly selected from each treatment for recording observations on vegetative and flowering parameters, except sprouting per cent and yield/ha., both characters were recorded on the basis of net plot area. Observations regarding days to sprouting, sprouting per cent and days to flowering were recorded in first year only, whereas bulb and bulblets yield and physico-chemical

properties were recorded at the end of experiment while remaining all observations were recorded for three years. The data of three years were pooled and analyzed statistically as per method suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth parameters

The data pertaining to vegetative growth parameters were significantly influenced by different treatments of land configuration and INM, except sprouting by INM are presented in Table 1 and 3.

Data presented in Table 1 showed significantly highest plant height (65.10 cm), number of leaves/plant (76.79) and leaf area (105.24 cm²) by 90 cm wide raised beds with three rows of plants (L_3). Leaves/plant and leaf area were at par with L_4 (raised beds of 120 cm wide with 4 rows), whereas, all the parameters were found lowest in flat bed method (L_1). The data presented in Table 3 clearly indicated that L_3 treatment of land configuration also recorded minimum days to sprouting (21.37) and maximum bulb sprouting percentage (98.28).

These findings are in accordance with the results of Ardeshta *et al.* (2013). They found that raised bed with 3 rows of plants recorded significantly higher plant height, stem girth and leaf area index than flat bed in turmeric at Navsari. Moreover, better plant growth under raised bed might be attributed by improvement in nutrient availability due to adequate air and water movement. Balashanmugam and Vedamuthu (1989) also reported similar results in turmeric.

Application of fertilizers with FYM @ 15 t/ha/year (I_2) recorded significantly highest plant height (63.44 cm), number of leaves/plant (71.16) and leaf area (99.56 cm²) followed by compost @ 10 t and fertilizer dose/ha/year (I_3). Though, the integrated nutrient management had no significant effect on sprouting parameters but earliest sprouting of bulbs (23.15) and maximum sprouting (96.04%)

Table 1 Growth parameters of tuberose as influenced by land configuration and INM (pooled data over three years)

Treatment	Plant height (cm)	Leaves/ plant	Leaf area (cm ²)	Florets/spike	Floret diameter (mm)
<i>Land configuration</i>					
L_1	56.62	55.64	82.49	33.78	35.00
L_2	61.56	62.19	90.72	36.79	36.01
L_3	65.10	76.79	105.24	43.52	36.58
L_4	61.22	67.90	95.82	38.70	35.90
CD (P=0.05)	3.42	10.62	9.90	3.60	NS
CV(%)	8.39	19.35	15.88	14.17	9.06
<i>Integrated nutrient management</i>					
I_1	59.08	60.88	86.83	36.33	35.30
I_2	63.44	71.16	99.56	39.93	36.55
I_3	60.86	64.84	94.31	38.32	35.77
CD (P=0.05)	1.91	5.31	4.63	NS	NS
CV(%)	6.25	16.35	9.90	18.29	10.86

Table 2 Growth parameters of tuberose as influenced by land configuration and INM (pooled data over three years)

Treatment	Rachis length (cm)	Spike length (cm)	Spike duration (days)	Vase life (days)	Spikes/plant/year	Spikes/ha/year
<i>Land configuration</i>						
L ₁	26.27	88.38	10.36	9.41	1.66	170492.54
L ₂	29.36	93.49	12.27	10.90	1.83	188689.56
L ₃	32.38	102.46	16.00	13.55	2.45	188850.31
L ₄	30.11	96.65	14.07	12.28	1.98	156322.34
CD (P=0.05)	3.65	3.06	1.40	0.59	0.11	13149.617
CV (%)	18.55	4.84	15.98	7.73	8.34	9.53
<i>Integrated nutrient management</i>						
I ₁	28.04	93.08	12.13	11.11	1.76	159258.05
I ₂	30.99	97.94	14.18	12.07	2.23	195577.74
I ₃	29.55	94.71	13.21	11.42	1.95	173430.27
CD (P=0.05)	NS	3.07	0.79	0.69	0.11	8847.12
CV(%)	17.14	6.46	11.93	12.02	11.35	10.60

Table 3 Sprouting, days to first floret opening, bulb and bulblets yield of tuberose as influenced by land configuration and INM

Treatment	Days to sprouting	Sprouting (%)	Days to first floret opening	Bulbs/plant	Bulbs/ha (1000)	Bulblets/plant
<i>Land configuration</i>						
L ₁	25.13	92.68	199.10	7.93	790.03	22.18
L ₂	24.62	93.80	156.92	9.16	914.26	27.11
L ₃	21.73	98.28	183.62	13.09	1030.79	31.00
L ₄	22.84	95.88	175.33	10.36	770.91	29.11
CD (P=0.05)	1.88	1.85	NS	1.87	104.52	5.59
CV(%)	6.93	1.68	24.95	16.02	10.34	17.71
<i>Integrated nutrient management</i>						
I ₁	23.83	94.59	191.39	9.65	836.28	25.68
I ₂	23.15	96.04	158.39	10.63	928.56	28.83
I ₃	23.77	94.85	186.45	10.12	864.64	27.53
CD (P=0.05)	NS	NS	20.76	0.80	75.00	2.48
CV(%)	7.25	1.73	24.95	9.14	9.89	10.46

were recorded in I₂ treatment (fertilizers with FYM).

Application of fertilizers with FYM @ 15 t/ha/year was more effective as compared to alone fertilizers as FYM plays an important role in improving soil permeability to air, water and water stable aggregates. Thus, application of organic materials such as farmyard manure considerably improves soil physical properties and nutrient uptake resulting in greater growth, yield and yield components. Kumar *et al.* (2015) also reported that the combination of FYM with fertilizers and biofertilizers improves maximum vegetative growth and sprouting in cv. Hyderabad Double.

Application of fertilizer dose with bio-compost @ 10 t/ha/year also recorded better effect on vegetative attributes than fertilizer dose alone because bio-compost is a rich source of organic carbon, improves microbial/biological properties of the soil (Partha and Sivasubramanian 2006).

The present findings are in close conformity with

findings of Kukde *et al.* (2006) and Srivastava *et al.* (2007) in tuberose.

Flowering and yield parameters

The data pertaining to flowering and yield parameters as influenced by different treatments of land configuration and INM are presented in Table 1, 2 and 3.

Different levels of land configuration didn't show significant effect on days to first floret opening, while, application of fertilizers with FYM (I₂) produced significantly advanced flowering by 158.39 days after planting of bulbs (Table 3).

In pooled analysis, significantly maximum florets/spike (43.52), rachis length (32.38 cm), spike length (102.46 cm), spike duration (16.00 days) and vase life (13.55 days) was recorded in L₃ treatment while minimum in plants grown on flat beds (L₁). However, floret diameter was recorded

Table 4 Physico-chemical properties of soil as influenced by land configuration and INM at the end of experiment

Treatment	OC (%)	EC (1:2.5) dsm ⁻¹	WSA% (>1.0 mm)	WSA% (0.5- 1.0 mm)	N (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)
<i>Land configuration</i>							
L ₁	0.35	0.66	49.32	19.02	292.00	67.87	398.22
L ₂	0.40	0.61	53.88	22.91	283.00	64.32	383.56
L ₃	0.47	0.47	59.58	28.02	264.11	53.78	362.44
L ₄	0.43	0.50	58.29	25.88	271.11	57.35	373.89
CD (P=0.05)	0.07	0.10	5.48	3.12	NS	6.45	19.98
CV(%)	14.56	15.77	8.60	11.29	9.20	9.19	4.56
<i>Integrated Nutrient Management</i>							
I ₁	0.39	0.58	53.35	22.65	280.33	62.39	384.17
I ₂	0.44	0.54	57.57	25.34	273.75	59.04	373.42
I ₃	0.42	0.56	54.88	23.88	278.58	61.06	381.00
CD (P=0.05)	0.03	NS	NS	NS	NS	NS	NS
CV(%)	9.67	18.21	9.21	14.12	6.21	7.86	6.13

non-significant by different levels of land configuration (Table 1 and 2).

Raised bed (90 cm wide) with 3 lines (L₃) produced significantly maximum number of spikes/plant (2.45) and spikes/ha (188850.31). At the end of experiment, significantly maximum bulbs/plant (13.09), bulbs/ha (103000.79) and bulblets/plant (31.00) were also recorded in the same treatment (L₃). It might be due to raised bed produced more vegetative growth in tuberose which leads to better quality flowers, more yield of spikes and bulbs. Panwar and Munda (2006) recorded parallel results in quality and yield of babycorn and Kuotsu *et al.* (2014) in groundnut.

Application of fertilizers (300:200:100 kg NPK/ha/year) along with FYM @ 15 t/ha (I₂) recorded higher florets/spike (39.93), maximum floret diameter (36.55 mm) and rachis length (30.99 cm) though it had no significant effect, whereas significantly maximum spike length (97.94 cm), spike duration (14.18 days) and vase life (12.07 days) were recorded with the same treatment.

Moreover, in INM, significantly maximum number of spikes/plant (2.23) and spikes/ha (195577.74) was recorded in the recommended dose of fertilizers with FYM (I₂), which was followed by application of recommended dose of fertilizer and bio compost @ 10 t/ha/year (I₃). Similarly, significantly maximum production of bulbs/plant (10.63), bulbs/ha (92800.56) and bulblets /plant (28.83) were recorded in I₂ which was at par with I₃ (fertilizer dose + bio compost @ 10 t/ha).

Venkateswarlu and Das (1986) also emphasized the need for application of fertilizers in conjunction with FYM for obtaining optimum yield. It might be due to combination of FYM with inorganic N and P fertilizers which result in alleviation of climatic and soil-related constraints like low soil water retention and low soil fertility.

Ardeshtna *et al.* (2013) reported significantly higher quality and yield with respect to number and weight of mother, and finger rhizomes/plant and per ha in turmeric.

Amzed *et al.* (2005) and Balashanmug and Vedamuthu (1989) recorded markedly higher yield of turmeric when planted on raised bed.

Physico-chemical properties of soil

Different treatments of land configuration and integrated nutrient management influenced physico-chemical properties of soil. Maximum organic carbon (0.47%), WSA below 1.0 mm (59.58%), WSA between 0.5-1.0 mm (28.02%) and minimum EC (0.47 d/m) were recorded in L₃ treatment, while, maximum available N (292.00 kg/ha), P (67.87 kg/ha) and K (398.22 kg/ha) were recorded in flat bed (L₁) at the end of the experiment (Table 4). Integrated nutrient management showed non-significant difference with EC, WSA and N, P and K at the end of the experiment. Significantly maximum organic carbon (0.44%) was recorded in soil of plot applied with recommended dose of fertilizer dose + FYM (15 t/ha) which was at par with I₃; i.e. 0.42%. Similar results were obtained by Selvaraju *et al.* (1999) when studied land configuration and soil nutrient management options for sustainable crop production on Alfisols and Vertisols of southern peninsular India.

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