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Effect of gypsum and integrated nutrient management practices on soil fertility and flower yield of tuberose (*Polianthes tuberosa* L.) in saline soils

Maduri Ashwini, A Girwani, G Satish and B Chandrasheker

Maduri Ashwini
Department of Floriculture and Landscape Architecture, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Telangana, India

A Girwani
Dean of Student Affairs (Retd.), Sri Konda Laxman Telangana State Horticultural University, Mulugu, Telangana, India

Dr. N Seenivasan
COE, Sri Konda Laxman Telangana State Horticultural University, Mulugu, Telangana, India

Dr. G Sathish
Assistant Professor, Department of Agriculture Statistics, Sri Konda Laxman Telangana State Horticultural University Mulugu, Telangana, India

B Chandra Sheker
Assistant Professor, Department of Soil Science and Agricultural Chemistry, College of Horticulture Mojerla, Telangana, India

Corresponding Author:
Maduri Ashwini
Department of Floriculture and Landscape Architecture, College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, Telangana, India

Abstract

The present investigation entitled **"**Effect of gypsum and integrated nutrient management practices on soil fertility and flower yield of tuberose (*Polianthes tuberosa* L.) in saline soils" was conducted at Post graduate research farm of college of Horticulture, Mojerla during the *rabi* season of 2019 in factorial randomized block design with sixteen treatments replicated three times. The treatments consisted of two soil conditions *i.e* native saline soil and native saline soil topped with tank silt and seven integrated nutrient management treatments *i.e* with combination of gypsum, FYM, poultry refuse, vermicompost and RDF with ¼ RDF as control. In this study application of tank silt on native saline soil along with gypsum @ 2.5t/ha + poultry refuse @ 5t/ha+1/4 RDF (P_2S_6) in tuberose var. Prajwal recorded significantly maximum plant height, plant spread at 30,60 and 90 DAS which were superior over the control. Further maximum flower yield and flower yield attributing characters *viz.*, individual floret weight, number of flowers per spike and number of spikes per plot increased significantly in same treatment combination P_2S_6 *i.e* Native saline soil topped with tank silt + gypsum (2.5t/ha) + poultry refuse (5t/ha) + ¼ RDF) followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) + Fym (5t/ha) + ¼ RDF).The tuberose flower quality parameters such as flower diameter and flower length were also found to be significantly superior in this treatment. Similar trend was recorded in tuberose bulb yield and bulb number per plant. Further the vase life of flower spikes was maximum (14.35 days) with the application of the INM treatment combination P_2S_6 *i.e* native saline soil topped with tank silt + gypsum (2.5t/ha) + poultry refuse (5t/ha) + ¼ RDF followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) +FYM+ ¼ RDF) (13.42 days). The soil nutrient status has increased with the application of tank silt + gypsum (2.5t/ha) + poultry refuse (5t/ha) + ¼ RDF and recorded maximum availability of Nitrogen (351.400 kg ha^{-1}), Phosphorous (47.267kg ha^{-1}), Potassium (364.000 kg ha -1) and Organic carbon (0.597%) after the harvest of the crop, further the pH of soil also reduced in this treatment. Thus, it can be concluded that under saline soil condition, application of tank silt along with gypsum, poultry refuse and ¼ recommended dose of fertilizers improves the soil health with decrease in soil pH in sodic soils which ultimately resulted in improvement in growth, quality and flower yield in tuberose var 'Prajwal'.

Keywords: Tuberose, gypsum, tanksilt, poultry refuse, vermicompost, FYM

Introduction

Tuberose (*Polianthes tuberosa* L.) belongs to the family Asparagaceae and is native of Mexico. It is one of the important bulbous flowering plants cultivated for its fragrant long lasting flower spikes and essential oil. It is locally called as "*Nelasampangi*''. The lingering delightful fragrance and excellent keeping quality are the predominant characteristics of tuberose flower. Due to its great demand in flower market, cultivation of tuberose is gaining momentum day by day in the world.

Tuberose is one of the important cut and loose flower in the tropical and sub-tropical regions of the world and it is cultivated all over the world for their flowers. Morocco, France, Hawaii, South Africa, Egypt, India and China are the major producers of tuberose. Tuberose is also one of the potentially valuable cut flowers and is an important commercial flower crop of our country. At present the area under tuberose cultivation in India is about 7.95 lakh hectares.

Cut flowers are used to decorate vases and bouquets, while individual florets are used for making veni, garland, button-holes or crown (Bose *et al.*, 1999) [4]. The flowers are attractive and elegant in appearance with sweet fragrance. It has long been cherished for the aromatic oils extracted from its fragrant white flowers.

Soil salinity is the factor for plant growth and high soil salinity cause nutrient imbalances which result in the accumulation of elements toxic to plants and reduce water infiltration.

Excessive salt accumulation adversely affects soil physical and chemical properties and also effects microbiological processes. In saline soils, the presence of excessive salts in the root zone lead to various physiological changes in the plant which ultimately affect the growth and flowering of the plant.

Gypsum is the most common amendment and its application is recommended for amelioration of saline and sodic soils. The effectiveness of gypsum depends, to some extent, on the surface area of its particles, its source whether natural or artificial, its rate and method of application (Balba, 1995) [3]. Application of gypsum to saline and sodic soils increased soil hydraulic conductivity and surface gypsum application decreased the soil bulk density. EC was significantly decreased by applying leaching water with or without gypsum. Gypsum application caused significant decrease in pH as well as ESP values of the studied soils (Youssef, 1992) [13]. EC and pH slightly decreased as a result of gypsum application to the soils (Ali, 1993) [1].

Tuberose plants responds well with the application of organic matter such as compost which has good balance of nutrients and maintains an ideal pH level. Organic matter decomposition and plant root action also help to dissolve the calcium compounds found in most soils, thus promoting reclamation of saline soil. Various organic amendments such as farmyard manure, compost, poultry manure and mulch can be used for the amelioration of saline soils. Organic amendments improve physical, chemical and biological properties of soils under saline conditions.

Materials and Methods

The present investigation entitled “Effect of gypsum and integrated nutrient management practices on soil fertility and flower yield of Tuberose (*Polianthes tuberosa* l.) in saline soils” was carried out during the *rabi* season of the year at College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University. The experiment was laid out with factorial randomized block design with 16 treatments. T_1- Native saline soil + FYM (5 t/ha) + ¼ RDF, T_2- Native saline soil + Poultry refuse (5 t/ha) + ¼ RDF, T_3- Native saline soil + Vermicompost (500 kg/ha) + ¼ RDF, T_4- Native saline soil + Gypsum (2.5 t/ha) + ¼ RDF, T_5- Native saline soil + Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF, T_6- Native saline soil + Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF (3 t /ha), T_7- Native saline soil + Gypsum (2.5 t/ha) + Vermicompost (500 kg/ha) + ¼ RDF, T_8-Native saline soil + Tank silt + FYM (5 t/ha) + ¼ RDF, T_9- Native saline Soil + Tank silt + Poultry refuse (5 t/ha) + ¼ RDF, T_{10}- Native saline Soil + Tank silt + Vermicompost (500 kg/ha) + ¼ RDF, T_{11}- Native saline Soil + Tank silt + Gypsum (2.5 t/ha) + ¼ RDF, T_{12}- Native saline Soil + Tank silt+ Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF, T_{13}- Native saline Soil + Tank silt+ Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF, T_{14}- Native saline Soil + Tank silt + Gypsum (2.5 t/ha) + Vermicompost (500 kg/ha) + ¼ RDF), T_{15}- Native saline soil + Tank silt + ¼ RDF, T_{16}- Native saline Soil + ¼ RDF(Control) The experimental was carried out on the tuberose cv Prajwal which was procured from farmers field in Palgutta village of Rangareddy district.

The experimental field was thoroughly ploughed with the help of mould board plough and cross harrowing was done with disc plough and the soil was brought to a good tilth. Well decomposed FYM @ 25t/ha was added. Beds of 3 m x2m size, path and channels were prepared as per layout plan

Tank silt is collected from the local dried tank in Mojerla during summer and soil was analyzed. The pH was 7.5. While all the organic manures were procured from local farmers. Before application of organic manures, gypsum application is done then well decomposed farmyard manure, Vermicompost, poultry refuse, tank silt, were incorporated into the demarcated experimental plots uniformly as per experiment design. Similarly, N, P and K were applied in the form of urea, single super phosphate and Murate of potash respectively. Urea was applied in two splits, the first dose as basal application and another dose at 25 days after planting. The entire dose of single super phosphate and Murate of potash were applied at the time of planting as basal dose as per the treatments

The tuberose bulbs of approximately 3cm diameter were planted in ridge and furrow system at a depth of 6cm. A light irrigation was given immediately after planting, so that the seeds were not disturbed with flow of water. The adopted seed rate is 40,000-50,000/ac.

The observations were recorded from five randomly selected plants and statistically analyzed for different growth parameters and floral parameters, bulb parameters, soil parameters

Results and Discussion

Plant spread (cm)

The data recorded on number of leaves per plant at 90 days after planting as influenced by soil condition and integrated nutrient management shows significant difference with the treatments is presented in Table 1.

The Soil condition significantly influenced the plant spread in tuberose. The maximum plant spread of 16.46cm was recorded in Native saline soil topped with tank silt whereas the plant spread was minimum (14.02cm) in Native saline soil when compared to all the treatments.

The integrated nutrient management (S) has significant influence on spread of plant after planting. The treatment of S_6 (Gypsum @ 2.5t/ha + poultry refuse @ 5t/ha + ¼ RDF) recorded maximum spread of plants (16.55cm) followed by S_5 (Gypsum @ 2.5t/ha + FYM @ 5t/ha + ¼ RDF) (16.10cm) whereas S_8 (control) recorded the minimum plant spread (13.46cm) than all the treatments.

The interaction between soil condition and integrated nutrient management on plant spread is significant. The treatment combination P_2S_6 (Native saline soil topped with tank silt + Gypsum @ 2.5t/ha + poultry refuse @ 5t/ha + ¼RDF) recorded maximum spread of plant (18.39cm) and it is followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum @ 2.5t/ha + FYM @ 5t/ha + ¼ RDF) (17.90 cm). The treatment combination minimum spread plant (12.45 cm) was recorded in control.

The plant spread was found maximum with T_6 and T_4 treatment which might be due to the treatment the plants might be getting optimum nutrients resulting in maximum vegetative growth compared to other treatments (Zannatul *et al.*, (2016) [14]

In the present study the results clearly indicate that the vegetative growth performance of tuberose was influenced by salinity of soil. There was reduction in growth of tuberose in native saline soil (P1) where the soil P_H is >8.5. This may be attributed to increased osmotic pressure which limit the normal uptake of water and nutrients. Plant tries to copeup with the situation by decreasing leaf area and hence allows the conservation of energy (Chaparzadehet *et al*., 2004) [6]. However application of tank silt rich in nitrogen along with organic amendments such as gypsum, poultry residue improved the plant growth in tuberose. The application of tank silt resulted in decrease in soil pH, EC and increase in soil organic carbon (Ramesh, 2001) [11].

Enhancement of crop productivity with tank silt was earlier reported by Annadurai *et al.*, (2005) [2]. Similarly, Bocchi and Tano (1994) [5] also confirm the present results who reported positive interaction between the combination of organic manures and urea as nitrogen source (Bocchi and Tano, 1994) [5].

Similar increase in plant growth was earlier reported by Kadam *et al.* (2016) [15] where application of tank silt @ 5 t ha^{-1} + FYM 2.5 t ha^{-1} + RDF to okra recorded significantly higher plant height, number of branches, leaf area and total dry matter at 30, 60 and 90 DAS followed by tank silt @5 t ha^{-1} + RDF which was superior over the control.

Number of spikes per plant

The data on number of spikes per plant as influenced by soil condition and integrated nutrient management shows significant difference with the treatments is presented in Table 2.

Soil condition significantly influenced the number of spikes per plant. P_1 (Native saline soil) recorded maximum number of spikes per plant (1.70). whereas P_2 (Native saline soil topped with tank silt) least number of spikes per plant (1.50).

The integrated nutrient management has significant influence on number of spikes per plant. The highest number of spikes per plant (2.06) was observed with S_6 (Gypsum (2.5t/ha) + poultry refuse (5t/ha) + ¼ RDF) followed by S_5 (Gypsum (2.5t/ha) +FYM (5t/ha) + ¼ RDF) (1.06) whereas, minimum number of spikes per plant was observed from S_8 (1.44) whereas least number of spikes observed (1.43) in S_3 (Vermicompost (500kg/ha) + ¼ RDF).

The interaction effect of soil condition and integrated nutrient management practices on number of spikes per plant was significant. The treatment combination P_2S_6 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) + poultry refuse (5t/ha) + 1/4 RDF) recorded maximum number of spikes per plant (2.41) followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) +FYM (5t/ha) +1/4RDF) (2.01). The treatment combination P_2S_4 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) + ¼ RDF) and P_2S_7 (Native saline soil topped with tank + Gypsum (2.5 t/ha) + vermicompost 500kg/ha + ¼ RDF) recorded minimum number of spikes per plant (1.11) whereas least number of spikes per plantP_2S_8 (Native saline soil topped with tank silt + ¼ RDF) control treatment (0.94).

The increase in spike yield in tuberose can be attributed to higher mineralization of various essential elements present in poultry manure and with minimal application of chemical fertilizers. This might have also increased microbial activity and organic colloids resulting in better availability and uptake of these elements ultimately resulting in increased photosynthetic activity in plants (Suseela *et al*., 2016) [10]

Number of days taken for first flowering

The data recorded on number of days taken for first flowering in tuberose as influenced by soil condition and integrated nutrient management shows significant difference with the treatments is presented in Table 3

Soil condition has significantly influenced the number of days taken for first flowering in tuberose. P_2 (Native saline soil topped with tank silt) recorded minimum number of days for first flowering (147 days). The treatment P_1 (Native saline soil) recorded maximum number of days for flowering (151).

The integrated nutrient management has significant influence on first flowering. The minimum number of days for first flower spike emergence (137 days) was observed from S_6 (Gypsum (2.5t/ha) + poultry refuse (5t/ha) + ¼ RDF) which is followed by S_4 (Gypsum (2.5t/ha) + ¼ RDF) (142.14 days). whereas, the maximum number of days (156 days) was observed from S8 (Control).

The interaction between soil condition and integrated nutrient management on number of days taken for first flowering is significant. The treatment combination P_2S_6 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) + poultry refuse (5t/ha) + ¼ RDF) recorded less number of days for flowering (128.92 days) followed by P_1S_4 (Native saline soil + Gypsum (2.5t/ha) + ¼ RDF) (137.20 days). The treatment combination P_2S_8 (Native saline soil topped with tank silt+ 1/4 RDF) recorded maximum number of days (163.16 days) for first flowering.

The early flowering in tuberose in this experiment is due to the combined application of tank silt, gypsum and poultry refuse which might have increased soil nitrate and reduced pH of saline soil which in turn promoted more availability of nutrients from soil and luxuriant plant growth. The early flowering may be due to more biomass accumulation in plants in tuberose. Results regarding improvement in flower yield and early flowering in tuberose are in accordance with the findings of Himaja *et al*. (2021) [7] in tuberose and Narute (2020) [8] in vegetables.

Number of florets per spike

The data on number of florets per spike as influenced by soil condition and integrated nutrient management shows significant difference with the treatments is presented in the Table 4.

Soil condition significantly influenced the number of florets per spike. P_1 (Native saline soil) recorded maximum number of florets per spike (37.83). Whereas P_2 (Native saline soil topped with tank silt) recorded the lowest number of florets per spike (36.92) than all the other treatments.

The integrated nutrient management has significant influence on number of florets per spike. The highest number of florets per spike (39.97) was with S_4 (Gypsum (2.5 t/ha) + ¼ RDF) treatment followed by S_5 (Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF) (39.70) whereas, the minimum number of florets per spike (34.70) was observed with S_1 (FYM (5 t/ha) + ¼ RDF). Whereas S_8 control recorded the lowest number of florets per spike (32.82) than all the other treatments.

The interaction effect between soil condition and integrated nutrient management showed statistically significant variation in terms on florets per spike. The highest number of florets per spike (42.71) was observed from P_2S_6 (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + poultry refuse (5 t/ha) + ¼ RDF) which is followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5t/ha) + FYM (5 t/ha) +¼ RDF) (41.13). Whereas P_2S_8 lower number of florets per spike (30.40).

Saline soil topped with tank silt and addition of gypsum along with poultry refuse (5t/ha) + ¼ RDF have promoted maximum number of florets per spike. This might be due to more availability of macro and micro nutrients from tank silt & poultry refuse under saline conditions. Suseela *et al*. (2016) [10]

Number of bulbs per plant

A perusal of data on number of bulbs per plant in tuberose as influenced by soil condition and integrated nutrient management shows significant difference with the treatments presented in the Table 5.

Soil condition significantly influenced the number of bulbs per plant. P_2 (Native saline soil topped with tank silt) recorded maximum number of bulbs per plant (7.77). Whereas P_1(Native saline soil) recorded least number of bulbs per plant (6.28).

The integrated nutrient management has significant influence on number of bulbs per plant. The highest number of bulbs (8.95) was observed with S_5 (Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF) followed by S_6 (Gypsum (2.5 t/ha) + poultry refuse (5 t/ha) + ¼ RDF) (7.99). Whereas S_8 (RDF) control recorded least number of bulbs per plant (5.22) than all the other treatments.

The interaction between soil condition and integrated nutrient management on number of bulbs per plant was significant. The treatment combination P_2S_6 (Native saline soil topped with tank silt+ Gypsum (2.5 t/ha) + poultry refuse (5 t/ha) + ¼ RDF) recorded maximum number of bulbs per plant (11.09) followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF) (9.96). Whereas P_2S_8 (Native saline soil topped with tank silt + ¼ RDF) least number of bulbs per plant (3.66) the remaining treatment combinations recorded intermediary values.

The number of bulbs per plant is recorded highest in combination (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF).

pH

The data on soil pH in soil as influenced by soil condition and integrated nutrient management shows significant difference with the treatments is presented in the Table.6

Statistically significant variation was recorded on pH in soil due to soil condition. The low pH (7) was recorded from P_2 (Native saline soil topped with tank silt). whereas P_1 (Native saline soil) recorded high pH (8).

The integrated nutrient management has significant influence on soil pH. Low pH (7.633) was with S_6 (Gypsum @ 2.5 t/ha) + Poultry refuse @ 5 t/ha + ¼ RDF) followed by S_5 (Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF) (7.833) whereas S_4 (Gypsum (2.5 t/ha) + ¼ RDF) recorded high pH (8.283) than all the other treatments.

The interaction between soil condition and integrated nutrient management showed statistically significant variation in terms of pH. The low pH (7.23) was observed from P_2S_6 (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF) followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF) (7.567). Whereas P_2S_8 control recorded high pH (8.400) than all the other treatment combinations. The remaining treatment combinations recorded intermediary values.

The pH is recorded low in combination (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF). The pH decrease in gypsum treated soil may be due to the replacement of exchangeable Na + during Na+ - Ca 2+ exchange and subsequent leaching. Reduction in sodic soil electrical conductivity (EC) due to gypsum amendments has also been reported by Rai *et al*., (2010) [9]. Electrical conductivity of control soil was higher as compared to reclaimed soils, which is the function of the ions present in soil.

Organic carbon

The data on organic carbon in soil as influenced by soil condition and integrated nutrient management shows significant difference with the treatments is presented in the table 7

Statistically significant variation was recorded on organic carbon in soil due to soil condition. The maximum organic carbon (0.530%) was recorded from P_2 (Native saline soil topped with tank silt). whereas P_1 (Native saline soil) recorded lowest organic carbon (0.480%).

The integrated nutrient management has significant influence on organic carbon the maximum organic carbon (0.568%) was with S_7 (Gypsum (2.5 t/ha) + vermicompost (500kg/ha) + ¼ RDF) followed by S_6 (Gypsum (2.5 t/ha) + Poultry refuse (5t/ha) + ¼ RDF) (0.543%) whereas S_8 (¼ RDF) recorded lowest organic carbon (0.290%) than all the other treatments.

The interaction between soil condition and integrated nutrient management showed statistically significant variation in terms of organic carbon. The maximum organic carbon (0.597%) was observed from P_2S_6 (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF) followed by P_2S_5 (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF) (0.590%). whereas P_2S_8 control recorded lowest organic carbon (0.290%) than all the other treatment combinations. The remaining treatment combinations recorded intermediary values.

The organic carbon is recorded highest in combination (Native saline soil topped with tank silt + Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF).

In the present experiment application of Poultry manure played a significant role in integrated nutrient management in tuberose cultivation under saline conditions due to its ability to enhance soil microbial activity, soil carbon, nitrogen content and porosity. Similar results were earlier reported by Veeramani *et al* (2011) [12] who reported more availability of macro (N, P, K, Ca, Mg, S) and micro-nutrients (Cu, Fe, Mn, B) in soil with application of poultry manure.

Table 1: Effect of gypsum and integrated nutrient management practices on plant spread (cm) of tuberose in saline soils

(Factor-2) INM treatments	(Factor-1) Soil condition		
	P1 – Native Saline soil	P2 – Native saline Soil topped with Tank silt	Mean
S1 - Farmyard manure (5 t/ha) + ¼ RDF	14.18	16.17	15.17
S2 - Poultry refuse (5 t/ha) + ¼ RDF	13.57	15.65	14.61
S3 - Vermicompost (500 kg/ha) + ¼ RDF	14.29	15.96	15.13
S4 – Gypsum (2.5t/ha) + ¼ RDF	13.33	17.31	15.32
S5 - Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF	14.30	17.90	16.10

S6 - Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	14.70	18.39	16.55
S7-Gypsum (2.5 t/ha) + Vermicompost (500 kg/ha) + ¼ RDF	13.42	17.74	15.58
S8 – Control (¼ RDF)	14.36	12.55	13.46
Mean	14.02	16.46	
	P	S	P×S
S.Em±	0.08	0.16	0.22
CD@5%	0.23	0.45	0.64

Table 2: Effect of gypsum and integrated nutrient management practices on number of spikes per plant of tuberose in saline soils

(Factor-2) INM treatments	(Factor-1) Soil condition		
	P1-Native Saline soil	P2-Native saline Soil topped with Tank silt	Mean
S1 - Farmyard manure (5 t/ha) + ¼ RDF	1.47	1.45	1.46
S2 - Poultry refuse (5 t/ha) + ¼ RDF	1.44	1.68	1.56
S3 - Vermicompost (500 kg/ha) + ¼ RDF	1.60	1.26	1.43
S4 - Gypsum (2.5t/ha) + ¼ RDF	1.99	1.11	1.55
S5 - Gypsum (2.5 t/ha) + FYM (5t/ha) + ¼ RDF	1.59	2.01	1.80
S6 - Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	1.71	2.41	2.06
S7-Gypsum (2.5 t/ha) + Vermicompost (500kg/ha) + ¼ RDF	1.89	1.11	1.50
S8 – Control (¼ RDF)	1.93	0.94	1.44
Mean	1.70	1.50	
	P	S	P×S
S.Em±	0.06	0.12	0.17
CD@5%	0.17	0.34	0.48

Table 3: Effect of gypsum and integrated nutrient management practices on days taken for flowering of tuberose in saline soils

(Factor-2) INM treatments	(Factor-1) Soil condition		
	P1-Native Saline soil	P2-Native saline Soil topped with Tank silt	Mean
S1 - Farmyard manure (5 t/ha) + ¼ RDF	160.85	151.22	156.0
S2 - Poultry refuse (5 t/ha) + ¼ RDF	155.06	149.49	152.2
S3 - Vermicompost (500 kg/ha) + ¼ RDF	154.26	150.62	152.4
S4 - Gypsum (2.5 t/ha) + ¼ RDF	137.20	147.08	142.14
S5 - Gypsum (2.5 t/ha) + FYM (5t/ha) + ¼ RDF	151.64	138.52	145.08
S6 - Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	146.13	128.92	137.53
S7 - Gypsum (2.5 t/ha) + Vermicompost (500kg/ha) + ¼ RDF	158.27	152.19	155.2
S8 – Control (¼ RDF)	150.57	163.16	156.8
Mean	151.75	147.65	
	P	S	P×S
S.Em±	1.35	2.70	3.81
CD@5%	3.89	7.79	11.01

Table 4: Effect of gypsum and integrated nutrient management practices on number of florets per spike of tuberose in saline soils

(Factor-2) INM treatments	(Factor-1) Soil condition		
	P1– Native saline soil	P_2 – Native saline Soil topped with Tank silt	Mean
S1 - Farmyard manure (5 t/ha) + ¼ RDF	35.81	33.58	34.70
S2 - Poultry refuse (5 t/ha) + ¼ RDF	40.74	34.19	37.47
S3 - Vermicompost (500 kg/ha) + ¼ RDF	41.00	32.74	36.87
S4 - Gypsum (2.5 t/ha) + ¼ RDF	39.96	39.98	39.97
S5 - Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF	38.26	41.13	39.70
S6 - Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	34.47	42.71	38.59
S7 - Gypsum (2.5 t/ha) + Vermicompost (500kg/ha) + ¼ RDF	37.15	40.66	38.91
S8 – Control (¼ RDF)	35.25	30.40	32.82
Mean	37.83	36.92	
	S	P	S×P
S.Em±	0.31	0.63	0.88
CD@5%	0.90	1.81	2.55

Table 5: Effect of gypsum and integrated nutrient management practices on number of bulbs per plant of tuberose in saline soils

(Factor-2) INM treatments	(Factor-1) Soil condition		
	P1-Native Saline soil	P2-Native saline Soil topped with Tank silt	Mean
S1 - Farmyard manure (5 t/ha) + ¼ RDF	7.50	6.36	6.93
S2 - Poultry refuse (5 t/ha) + ¼ RDF	6.59	5.60	6.09
S3 - Vermicompost (500 kg/ha) + ¼ RDF	6.11	9.24	7.67
S4 - Gypsum (2.5 t/ha) + ¼ RDF	3.97	8.45	6.21
S5 - Gypsum (2.5 t/ha) + FYM (2.5 t/ha) + ¼ RDF	7.95	9.96	8.95
S6 - Gypsum (2.5t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	4.88	11.09	7.99

S7 - Gypsum (2.5 t/ha) + Vermicompost (500 kg/ha) + ¼ RDF	6.45	7.79	7.12
S8 – Control (¼ RDF)	6.78	3.66	5.22
Mean	6.28	7.77	
	P	S	P×S
S.Em±	0.12	0.23	0.33
CD@5%	0.34	0.67	0.95

Table 6: Effect of gypsum and integrated nutrient management practices on p^H in saline soils

(Factor-2) INM treatments	(Factor-1) soil condition		
	P1-Native saline soil	**P2-Native saline Soil topped with Tank silt**	**Mean**
S1 - Farmyard manure (5 t/ha) + ¼ RDF	8.033	8.100	8.067
S2 - Poultry refuse (5 t/ha) + ¼ RDF	8.067	7.733	7.900
S3 - Vermicompost (500 kg/ha) + ¼ RDF	8.200	8.200	8.200
S4 - Gypsum (2.5 t/ha) + ¼ RDF	8.200	8.367	8.283
S5 - Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF	8.100	7.567	7.833
S6 - Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	8.133	7.233	7.633
S7-Gypsum (2.5 t/ha) + Vermicompost (500 kg/ha) + ¼ RDF	8.200	8.200	8.200
S8 – Control (1/4 RDF)	8.033	8.400	8.217
Mean	8.121	7.975	
	P	S	P×S
S.Em±	0.036	0.072	0.102
CD@5%	0.105	0.210	0.297

Table 7: Effect of gypsum and integrated nutrient management practices on organic carbon (%) in saline soils

(Factor-2) INM treatments	(Factor-1) soil condition		
	P1-Native Saline soil	**P2-Native saline Soil topped with Tank silt**	**Mean**
S1 - Farmyard manure (5 t/ha) + ¼ RDF	0.390	0.557	0.473
S2 - Poultry refuse (5 t/ha) + ¼ RDF	0.487	0.533	0.510
S3 - Vermicompost (500 kg/ha) + ¼ RDF	0.517	0.560	0.538
S4 – Gypsum (2.5 t/ha) + ¼ RDF	0.453	0.540	0.497
S5 - Gypsum (2.5 t/ha) + FYM (5 t/ha) + ¼ RDF	0.450	0.590	0.520
S6 - Gypsum (2.5 t/ha) + Poultry refuse (5 t/ha) + ¼ RDF	0.490	0.597	0.543
S7 – Gypsum (2.5 t/ha) + Vermicompost (500 kg/ha) + ¼ RDF	0.560	0.577	0.568
S8 – Control (¼ RDF)	0.493	0.290	0.392
Mean	0.480	0.530	
	P	S	P×S
S.Em±	0.009	0.018	0.026
CD@5%	0.026	0.053	0.075

Conclusion

It could be concluded from the present study that, under saline soil conditions
(>8.5PH) topping with tank silt and integrated nutrient management practices such as application of gypsum along with poultry refuse significantly influence the growth, flowering, bulb production and soil health of Tuberose var. Prajwal.

- Among the different treatments, topping of native saline soil with tank silt + gypsum @2.5 t/ha + poultry refuse @ 5t/ha + ¼ dose of recommended dose fertilizers (200 kg N: 200 kg P_2O_5 + 200 kg K_2O) proved to be the best treatments for increase in growth, flower yield and vase life of tuberose var Prajwal.
- Further this treatment also maintained the sound soil health with increase in available nitrogen (kg/ha), phosphorous (kg/ha), potassium (kg/ha), pH, organic carbon (%) and EC in native saline soil.

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