Effect ofIntegratedNutrientManagementon theGrowthofTuberose(*Polianthestuberosa*L.) cv. Rajat Rekha

ABSTRACT

The present experiment on effect of integratednutrientmanagementon thegrowthofTuberose(*Polianthestuberosa*L.) cv. Rajat Rekha was carried out during 2021-22 and 2022-23 at Horticulture Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut.The experiment consists of eighteen treatments which were replicated three times in Randomizedcompletelyblockdesign. The results of investigation revealed that the treatment applied with 75% RDF **+** 2kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum(T_{15}) was found to be best in all the growth characters *viz.*, days taken for spouting (12.10 & 14.18), plant height (40.8 & 41.7cm), length of leaves (48.0 & 48.6cm), width of leaves (1.78 & 1.80cm), and number of leaves (60.8 & 61.4).

Keywords : Tuberose, FYM, Vermicompost, PSB and Azospirillum.

Comment [NJ1]: Rewrite the sentence. It is too long. Location and experimental design may be included only in the materials and methods section.

Comment [NJ2]: Or completely randomized block design?

Comment [NJ3]: Use the expansions in first usage

Introduction

Tuberose (*Polianthes tuberosa* L.) belongs to family Agavaceae and is native of Mexico. It is a one of the most important tropical bulbous flowering plants cultivated for production of long lasting flower spikes. It is popularly known as Rajanigandha. Commercial importance of tuberose is due to beauty of the flower, longer vase-life of spikes and aromatic oil extracted from its fragrant white flower and it has a great economicpotentialforcutflowertradeandessentialoilindustry**(Alan*etal.*,2007)**.

Ithasgreatdemandforhomedecoration,garland,flowerdecoration,bouquetsandpots,in addition to the purpose of cutting flowers. It's essential oil is rich in geraniol, nerol, benzylalcohol, eugenol, benzyl benzoate and methyl anthranilate and methyl salicylate**(Hussain,1986)**. Tuberose is a gross feeder and requires a large quantity of NPK, both in the form of organic and inorganic fertilizers (**Amarjeet and Godara, 1998).** INMhelpsinmaintainingor enhancing soilproductivitythroughabalanceduseoffertilizers combinedwithorganicandbiologicalsourcesofplantnutrients,improvingthestockofplantnutrientsint

hesoilsandimprovetheefficiencyofplantnutrients,thus,limitinglossestotheenvironment. In the present investigations, studies have been made to know the effect of integratednutrientmanagementon thegrowthofTuberose(*Polianthestuberosa*L.) cv. Rajat Rekha.

Material and Methods

The experimentwas carried out at Horticulture Research Centre, Sardar VallabhbhaiPatel University of Agriculture & Technology, Meerut, Uttar Pradesh (India) during seasons of 2021-22 and 2022-23. The experiment was laid out in Randomized Block Design with eighteen treatments and three replications. Bulbs of tuberose cv. Rajat Rekha were planted in a spacing 30 cm × 30 cm. The different treatments wereT_1 (control), T_2(100% RDF), T_3(50% RDF**+** 2 kg FYM/m^2+ PSB + Azospirillum), T_4 (50% RDF**+** 1 kg FYM/m^2+ PSB + Azospirillum), T_5 (50% RDF**+** 300g VC/m^2+ PSB + Azospirillum), T_6(50% RDF**+** 150g VC/m^2+ PSB + Azospirillum), T_7(50% RDF**+** 2 kg FYM/m^2 + 300g VC/m^2+ PSB + Azospirillum), T_8 (50% RDF**+** 1 kg FYM/m^2 + 300g VC/m^2+ PSB + Azospirillum), T_9 (50% RDF**+** 2 kg FYM/m^2 + 150g VC/m^2+ PSB + Azospirillum), T_{10}(50% RDF**+** 1 kg FYM/m^2 + 150g VC/m^2+ PSB + Azospirillum), T_{11}(75% RDF**+** 2 kg FYM/m^2+ PSB + Azospirillum), T_{12} (75% RDF**+** 1 kg FYM/m^2+ PSB + Azospirillum), T_{13}(75% RDF**+** 300g VC/m^2+ PSB + Azospirillum), T_{14} (75% RDF**+** 150g VC/m^2+ PSB + Azospirillum), T_{15} (75% RDF**+** 2 kg FYM/m^2 + 300g VC/m^2+ PSB + Azospirillum), T_{16} (75% RDF**+** 1 kg FYM/m^2 + 300g VC/m^2+ PSB + Azospirillum), T_{17} (75% RDF**+** 2 kg FYM/m^2 + 150g VC/m^2+ PSB + Azospirillum) andT_{18}(75% RDF**+** 1 kg FYM/m^2 + 150g VC/m^2+ PSB + Azospirillum. Manures were applied and mixed into the soil thoroughly. The amount and type of manure applied was as per the treatments of respective plots. Cultural practices were kept uniform for all the treatments and standard practices were adopted to raise the crop successfully. Observation on growth attributes *i.e.* days taken for spouting,plant height (cm), length of leaves (cm), width of leaves (cm) and number of leaves per plant.

Comment [NJ4]: Use expansions of RDF, FYM, VC, PSB etc in the first usage

Result and Discussion

The minimum days taken for spouting (12.10 & 14.18) was recorded in T_{15} (75% RDF + 2kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum) and found statistically at par with T_{16} (14.21 & 15.25 days), T_{17} (14.18 & 15.20 days) and T_{18} (14.12 & 15.16 days).The earliest emergence of bulbs in Vermicompost + RDFmight be due to the early absorption ofN, P and K increased the availability of micronutrients as well as planthormones due to which the time taken for emergence of bulbs was reducedsignificantly. Padaganur*et al.* (2005), Kabir *et al.* (2011) and Hadwani*et al.,* 2013) reported similarresults in tuberose ~~flowers~~.

The maximum plant height (40.8 & 41.7cm) was recorded in T_{15} (75% RDF + 2kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum), and found statistically at par with T_{11} (38.2 & 39.5cm), T_{12} (37.4 & 38.2cm), T_{13} (39.0 & 39.8cm), T_{14} (38.6 & 39.7cm), T_{16} (40.2 & 41.4cm), T_{17} (39.7 & 40.3cm) and T_{18} (39.4 & 40.1cm). However, minimum plant height (28.4 & 30.6cm) was found in control. The result shows nitrogen and phosphorus had positive correlation with the plant height, its nutrient availability is increased with increase in organic sources viz. FYM, vermicompost and PSB. Nitrogen, a constituent of protein and is essential for formation of protoplasm, cell division and cell enlargement, while phosphorus a part of nucleic acids and also responsible for root development and the combined effect of higher availability of both nutrients in plant vicinity enhance the vegetative growth of the plant (Dahiya *et al*., 2001, Yadav *et al*., 2005 andKumar*et al.*,2014).

The maximum length of leaves (48.0 & 48.6cm) was recorded in T_{15} (75% RDF + 2kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum) and found statistically at par with T_{11} (44.7 & 45.1cm), T_{12} (43.8 & 44.3cm), T_{13} (45.5 & 45.9cm), T_{14} (44.8 & 45.4cm), T_{16} (46.8 & 47.3cm), T_{17} (45.7 & 46.4cm) and T_{18} (45.7 & 46.1cm). However, minimum length of leaves (37.2 & 37.8cm) was found in control. The results revealed that length of leaves was~~ere~~ greater with organic fertilizer application along with chemical fertilizers. These results indicate that application of organic fertilizers had tremendous effects on plant growth and development in tuberose. Further the effect was more pronounce in FYM + vermicompost + PSB combination followed by FYM + PSB ~~`~~combination. These results have conformity with the result of Padaganur*et al.* (2010) who

reported that application of organic fertilizers along with chemical fertilizers enhanced plant growth and development in tuberose.Similear findings were reported byDesai and Thirumala (2015).

The maximum width of leaves (1.78 & 1.80cm) was recorded in T_{15} (75% RDF + 2kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum) and found statistically at par with T_{11} (1.70 & 1.72cm), T_{12} (1.68 & 1.72cm), T_{13} (1.72 & 1.75cm), T_{14} (1.71 & 1.73cm), T_{16} (1.76 & 1.78cm), T_{17} (1.75 & 1.77cm) and T_{18} (1.74 & 1.76cm). However, minimum width of leaves (1.48 & 1.50cm) was found in control. The results indicated that essentiality of nitrogenous element in organicform enhanced to constitute chlorophyll which leads to better leaves overcontrol treatment. Kadu *et al.* (2009) reported that the profound effect ofnitrogen fertilization on anatomical structure of tuberose. Similar results were also reported by Meena *et al*., (2015).

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The maximum number of leaves (60.8 & 61.4cm) was recorded in T_{15} (75% RDF + 2kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum) and found statistically at par with T_{16} (58.3 & 60.3cm), T_{17} (56.9 & 57.4cm) and T_{18} (56.2 & 56.8cm). However, minimum number of leaves (32.1 & 34.6cm) was found in control.Kabir *et al* (2011) also noted that the number of leaves was significantly increased with the application of half of chemical fertilizer along with vermicompost in tuberose.These findings are in agreement withPradhan*etal*., (2017).

Conclusion

On the basis of finding of two consecutive years of experiments, it can be concluded that treatment T_{15} (75% RDF + 2 kg FYM/m^2 + 300g VC/m^2 + PSB + Azospirillum) may be recommended to farmers of Meerut district, Uttar Pradesh for better growth of tuberose.

Table 1 Days taken for sprouting in relation to INM treatments during ~~2021-22 and 2022~~-23

Symbol	Treatments	Ist year	IInd year
		~~2021-22~~	~~2022-23~~
T_1	Control	20.17	22.29
T_2	100%RDF	16.14	17.22
T_3	50%RDF+2 kg FYM/m^2+ PSB +Azospirillum	19.16	20.26
T_4	50%RDF+1 kg FYM/m^2+ PSB +Azospirillum	20.17	21.28
T_5	50%RDF+300g VC/m^2+ PSB +Azospirillum	18.15	19.25
T_6	50%RDF+ 150g VC/m^2+ PSB +Azospirillum	19.16	20.26
T_7	50%RDF+2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	16.14	17.22
T_8	50%RDF+1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	17.18	18.24
T_9	50%RDF+2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	17.10	18.20
T_{10}	50%RDF+1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	18.15	19.25
T_{11}	75%RDF+2 kg FYM/m^2+ PSB +Azospirillum	15.13	16.21
T_{12}	75%RDF+1 kg FYM/m^2+ PSB +Azospirillum	16.14	17.22
T_{13}	75%RDF+300g VC/m^2+ PSB +Azospirillum	15.13	16.21
T_{14}	75%RDF+150g VC/m^2+ PSB +Azospirillum	15.10	16.17
T_{15}	75%RDF+2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	12.10	14.18
T_{16}	75%RDF+1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	14.21	15.25
T_{17}	75%RDF+2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	14.18	15.20
T_{18}	75%RDF+1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	14.12	15.16
	SEm+	**0.59**	**0.63**
	C.D. (P=0.05)	**1.68**	**1.79**

Comment [NJ6]: Table title may be rewritten as The effect of integrated nutrient management treatment on sprouting of Tuberose.

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Comment [NJ7]: I think it is not needed inside the table as it is mentioned in the materials and methods

Table 2 Plant height (cm) in relation to INM treatments at 180 days after planting the bulbs during 2021-22 and 2022-23

Symbol	Treatments	Ist year	IInd year
		2021-22	2022-23
T_1	Control	28.4	30.6
T_2	100%RDF	37.0	38.4
T_3	50%RDF+2 kg FYM/m^2+ PSB +Azospirillum	33.9	34.8
T_4	50%RDF+1 kg FYM/m^2+ PSB +Azospirillum	33.0	34.4
T_5	50%RDF+300g VC/m^2+ PSB +Azospirillum	35.1	36.4
T_6	50%RDF+ 150g VC/m^2+ PSB +Azospirillum	34.5	35.6
T_7	50%RDF+2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	36.9	37.8
T_8	50%RDF+1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	36.5	37.5
T_9	50%RDF+2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	36.0	37.1
T_{10}	50%RDF+1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	35.7	36.4
T_{11}	75%RDF+2 kg FYM/m^2+ PSB +Azospirillum	38.2	39.5
T_{12}	75%RDF+1 kg FYM/m^2+ PSB +Azospirillum	37.4	38.2
T_{13}	75%RDF+300g VC/m^2+ PSB +Azospirillum	39.0	39.8
T_{14}	75%RDF+150g VC/m^2+ PSB +Azospirillum	38.6	39.7
T_{15}	75%RDF+2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	40.8	41.7
T_{16}	75%RDF+1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	40.2	41.4
T_{17}	75%RDF+2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	39.7	40.3
T_{18}	75%RDF+1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	39.4	40.1
	SEm+	**1.32**	**1.36**
	C.D. (P=0.05)	**3.74**	**3.85**

Table 3 Length of leaves (cm) in relation to INM treatments during 2021-22 and 2022-23

Symbol	Treatments	Ist year	IInd year
		2021-22	2022-23
T_1	Control	37.2	37.8

T_2	100%RDF	43.7	44.2
T_3	50%RDF**+**2 kg FYM/m^2+ PSB +Azospirillum	37.7	38.0
T_4	50%RDF**+**1 kg FYM/m^2+ PSB +Azospirillum	37.5	37.8
T_5	50%RDF**+**300g VC/m^2+ PSB +Azospirillum	38.1	38.4
T_6	50%RDF**+** 150g VC/m^2+ PSB +Azospirillum	38.0	38.4
T_7	50%RDF**+**2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	42.8	43.2
T_8	50%RDF**+**1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	41.4	42.0
T_9	50%RDF**+**2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	38.7	39.0
T_{10}	50%RDF**+**1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	38.3	38.7
T_{11}	75%RDF**+**2 kg FYM/m^2+ PSB +Azospirillum	44.7	45.1
T_{12}	75%RDF**+**1 kg FYM/m^2+ PSB +Azospirillum	43.8	44.3
T_{13}	75%RDF**+**300g VC/m^2+ PSB +Azospirillum	45.5	45.9
T_{14}	75%RDF**+**150g VC/m^2+ PSB +Azospirillum	44.8	45.4
T_{15}	75%RDF**+**2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	48.0	48.6
T_{16}	75%RDF**+**1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	46.8	47.3
T_{17}	75%RDF**+**2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	45.9	46.4
T_{18}	75%RDF**+**1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	45.7	46.1
	SEm+	**1.51**	**1.52**
	C.D. (P=0.05)	**4.28**	**4.32**

Table 4 Width of leaves (cm) in relation to INM treatments during 2021-22 and 2022-23

Symbol	**Treatments**	**I^{st} year**	**II^{nd} year**
		2021-22	**2022-23**
T_1	Control	1.48	1.50
T_2	100%RDF	1.67	1.70
T_3	50%RDF**+**2 kg FYM/m^2+ PSB +Azospirillum	1.56	1.58
T_4	50%RDF**+**1 kg FYM/m^2+ PSB +Azospirillum	1.54	1.56
T_5	50%RDF**+**300g VC/m^2+ PSB +Azospirillum	1.60	1.63
T_6	50%RDF**+** 150g VC/m^2+ PSB +Azospirillum	1.58	1.60
T_7	50%RDF**+**2 kg FYM/m^2 +300g VC/m^2+ PSB	1.65	1.68

	+Azospirillum		
T_8	50%RDF**+**1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	1.64	1.66
T_9	50%RDF**+**2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	1.62	1.65
T_{10}	50%RDF**+**1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	1.61	1.63
T_{11}	75%RDF**+**2 kg FYM/m^2+ PSB +Azospirillum	1.70	1.72
T_{12}	75%RDF**+**1 kg FYM/m^2+ PSB +Azospirillum	1.68	1.71
T_{13}	75%RDF**+**300g VC/m^2+ PSB +Azospirillum	1.72	1.75
T_{14}	75%RDF**+**150g VC/m^2+ PSB +Azospirillum	1.71	1.73
T_{15}	75%RDF**+**2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	1.78	1.80
T_{16}	75%RDF**+**1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	1.76	1.78
T_{17}	75%RDF**+**2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	1.75	1.77
T_{18}	75%RDF**+**1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	1.74	1.76
	SEm+	**0.06**	**0.06**
	C.D. (P=0.05)	**0.17**	**0.17**

Table 5 Number of leaves in relation to INM treatments at 180 days after planting the bulbs during 2021-22 and 2022-23

Symbol	**Treatments**	**Ist year**	**IInd year**
		2021-22	**2022-23**
T_1	Control	32.1	34.6
T_2	100%RDF	46.3	47.9
T_3	50%RDF**+**2 kg FYM/m^2+ PSB +Azospirillum	36.7	37.2
T_4	50%RDF**+**1 kg FYM/m^2+ PSB +Azospirillum	35.6	36.4
T_5	50%RDF**+**300g VC/m^2+ PSB +Azospirillum	38.9	39.8
T_6	50%RDF**+** 150g VC/m^2+ PSB +Azospirillum	37.3	38.4
T_7	50%RDF**+**2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	44.8	45.8
T_8	50%RDF**+**1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	42.8	43.6
T_9	50%RDF**+**2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	40.7	42.8

T_{10}	50%RDF**+**1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	40.1	41.6
T_{11}	75%RDF**+**2 kg FYM/m^2+ PSB +Azospirillum	49.5	50.6
T_{12}	75%RDF**+**1 kg FYM/m^2+ PSB +Azospirillum	47.8	48.2
T_{13}	75%RDF**+**300g VC/m^2+ PSB +Azospirillum	53.6	54.8
T_{14}	75%RDF**+**150g VC/m^2+ PSB +Azospirillum	51.9	52.7
T_{15}	75%RDF**+**2 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	60.8	61.4
T_{16}	75%RDF**+**1 kg FYM/m^2 +300g VC/m^2+ PSB +Azospirillum	58.3	60.3
T_{17}	75%RDF**+**2 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	56.9	57.4
T_{18}	75%RDF**+**1 kg FYM/m^2 +150g VC/m^2+ PSB +Azospirillum	56.2	56.8
	SEm+	**1.67**	**1.71**
	C.D. (P=0.05)	**4.74**	**4.85**

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