Response of GA_3 to morphological characteristics of tuberose incorporated with organic manures

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Abstract-The present work was conducted at Horticultural Farm of Sher-e-Bangla Agricultural University, Bangladesh to study the morphological characteristics of tuberose as influenced by gibberellic acid incorporated with organic manures. The experiment consisted with three levels of organic manure; control, cow dung 30 tha^{-1} and poultry litter 20 t ha^{-1}behind with 0 ppm, 100 ppm, 200 ppm and 300 ppm gibberellic acid were tested with three replications. Application of organic manures with GA_3 showed significant variations among the parameters. Yield of spike (3,50,000 ha^{-1}) and bulb (21.72 t ha^{-1}) was recorded in poultry litter @ 20 t ha^{-1} with 200 ppm GA_3 compared to other treatments which was more potential for production of tuberose.

Index Terms- Cut-flower, compost, organic matter, PGRs, tuberose

I. INTRODUCTION

Tuberose (*Polianthes tuberosa* L.) is bulbous plant of the family Amaryllidaceae. It is one of the most popular cut-flower commercially cultivating in Bangladesh due to its attractive, elegant and fragrant white flowers. It has become an impediment part of decorating a bouquet for its sweet pleasant, prettiness display and long vase life (Patel et al. 2006).It has high demand in the market and its production is highly profitable. In Bangladesh, its commercial cultivation was introduced during 1980 but the production still now is not satisfactory. Plant growth and economic cultivation of tuberose are affected by many factors like smulching, fertilizer,PGRs etc. Tuberose is a gross feeder plant receives a large quantity of NPK as organic and inorganic form which have great influence on growth, flower and bulb production (Kumar et al.2004, Sultana et al.2006 and Rajwal and Singh 2006).Organic manures decrease soil salinity, increase the organic matter, improve the soil structure and, increase water and air permeability in soil (Ikram et al.2012). Also, the potential use of plant growth regulator like GA_3 in flower production has created considerable scientific interest in recent years (Padaganur et al.,2005; Singh et al., 2003). In Bangladesh, it is necessary to know the real impact of plant growth regulator like GA_3 and organic manureson tuberose. So, present investigation was undertaken to modify the floral and yield contributing characters of tuberose using GA_3 and organic manures.

II. MATERIALS AND METHOD

The experiment was conducted during April 2013 to March 2014 at Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. Geographically the experimental area is located at $23^0$41 N latitude and $90^0$22 E longitudes at the elevation of 8.6 m above the sea level belongs to the Modhupur Tract under AEZ No. 28. This area characterized by three distinct seasons, the monsoon or the winter season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October. Four levels of GA_3 @ 0, 100, 200 and 300 ppm as represented by G_0, G_1, G_2 and $G_3$and three levels of organic manure; control, cow dung 30 t ha^{-1} and poultry litter 20 t ha^{-1} represented by M_0, M_1 and M_2 respectively were tested on tuberose in randomized complete block design with three replications. Bulbs were planted on 21 April 2013 at spacing of 30 x 20 cm. Spraying was done 40 days, 50 days and 60 days after transplanting. The spikes of tuberose were harvested when the first floret in the rachis opened during 5 August to 10 September and bulbs were on 20 March 2014. The significance of the difference among the treatment combinations of means was estimated by least significance difference (LSD) at 5% level of probability.

Table 1: Physical and chemical properties of the experimental soil

Constituents	**Values**
Physical properties and mechanical fractions	
Sand (2.0-0.05 mm) (%)	27
Silt (0.05-0.002 mm) (%)	43
Clay (<0.002 mm) (%)	30
Textural class	Silty-clay
Particle density (g ccG^{-1})	2.6
Bulk density (g ccG^{-1})	1.45
Porosity	44.23
Soil properties: Chemical analysis	**Values**
pH (1:2.5 soil-water)	6.1

Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.077
Available P (ppm)	20.00
Available K (ppm)	15.63
Available S (ppm)	9.05

III. RESULTS AND DISCUSSION

Plant height

Significant variation was recorded due to interaction effect of organic manures and GA_3 in terms of plant height of tuberose (Table 2). The tallest plant (44.00 cm and 60.73 cm) was recorded in M_2G_2 at 45 and 90 DAP whereas the shortest plant was recorded in M_0G_0. It was revealed that M_2G_2 ensure maximum vegetative growth by ensuring organic manure immediate after germination that lead to the development of plants and the ultimate results was the highest plant height of tuberose. Organic manure has great influence on growth in tuberose (Yadav et al. 1985). This result is in agreement with the findings of (Wankhade et al. 2002a, Sharma et al. 2004, Rana et al. 2005, Bhalla and Kumar 2008, Kumar et al. 2008, Awasthi et al. 2012, Chopde et al. 2012, Dogra et al. 2012, Sudhakar and Kumar 2012 and Sarkar et al. 2014) where they reported that, the growth parameters of gladiolus plants were significantly altered due to the application of growth regulators.

Number of leaves plant^{-1}

Significant variation was recorded on number of leaves plant^{-1} due to effect of organic manures and GA_3 (Table 2). The highest number of leaves plant^{-1} (8.6 and 26.25) was attained in M_2G_2 at 45 and 90 DAP whereas the lowest number of leaves plant^{-1} was found in M_0G_0. This result is also in agreement with the findings of (Wankhade et al. 2002b, Sharma et al. 2004, Rana et al. 2005, Bhalla and Kumar 2008, Kumar et al. 2008, Awasthi et al. 2012, Chopde et al. 2012, Dogra et al. 2012, Sudhakar and Kumar 2012 and Sarkar et al. 2014) where they reported that, the growth parameters of gladiolus plants were significantly altered due to the application of growth regulators.

Number of side shoot plant^{-1}

In case of number of side shootplant^{-1}, organic manures and GA_3 showed no significant variation in all the data of value recorded (Table 2).

Table 2. Influence of organic manures and gibberellic acid on vegetative characters of tuberose

Treatments		Plant height (cm) at		Number of leaves plant^{-1} at		Number of side shoot plant^{-1} at	
Organic manures	GA_3	45 DAP	90 DAP	45 DAP	90 DAP	45 DAP	90 DAP
Control	Control: Water spray	34.60 g	46.97 f	5.30 g	15.41 i	1.67	4.42
	GA_3 at 100 ppm	38.60 b-e	53.19 de	6.30 ef	17.93 f	1.44	4.73
	GA_3 at 200 ppm	38.60 b-e	53.59 de	6.30 ef	17.31 f	1.57	4.88
	GA_3 at 300 ppm	36.00 fg	48.40 d	6.00 f	18.70 g	1.62	4.92
Cowdung 30 t ha^{-1}	Control: Water spray	36.30 e-g	52.89 de	6.60 de	19.59 e	1.57	4.97
	GA_3 at 100 ppm	38.60 b-e	55.05 cd	7.00 cd	19.88 e	1.87	4.13
	GA_3 at 200 ppm	36.60 d-g	55.72 bc	7.00 cd	23.11 c	1.83	4.11
	GA_3 at 300 ppm	37.60 c-f	54.15 cd	7.00 cd	16.11 h	1.96	5.25
Poultry litter 20 t ha^{-1}	Control: Water spray	39.00 b-d	55.47 c	7.00 cd	21.05 d	1.99	5.45
	GA_3 at 100 ppm	40.00 bc	60.61 b	7.60 b	24.92 b	2.07	5.48
	GA_3 at 200 ppm	44.00 a	60.73 a	8.60 a	26.25 a	2.36	5.58
	GA_3 at 300 ppm	40.30 bc	57.47 bc	7.30 bc	23.40 c	2.23	5.30
LSD $_{(0.05)}$		2.10	1.75	0.36	0.65	---	---
Level of significance		*	*	*	*	ns	ns
CV (%)		3.30	3.02	4.11	4.14	6.79	5.04

* = Significant at 5% level of probability; ns = Non-significant

Flowering plant percentage

Flowering plant of tuberose varied significantly for the application of organic manures and GA_3 (Table 3). The maximum flowering plant (98.33 %) was found in M_2G_2 whereas, the minimum flowering plant (71.00 %) was recorded in M_0G_0. Organic sources have great influence flower production in tuberose. It was revealed that M_2 produced maximum flowering plant compare to other organic manure that used under this experiment. Tuberose plants treated with GA_3 at 200 ppm were found early flowering. It was also reported by (Sanap et al. 2000, Naggar et al. 2002, Tiwari and Singh 2002, Yang et al. 2002,Hasanuzzaman et al. 2007, Devadanam et al. 2007, Dogra et al. 2012, Sudhakar and Kumar 2012 and Sarkar et al. 2014) where they stated that, PGRs promotes vegetative growth, increases the photosynthetic and metabolic activities causing more transport and utilization of photosynthetic products resulting early

flowering in gladiolus. Das et al. (2015) also found similar result in case of Bell Pepper where he reported that flowering occurs earlier in those plants where PGRs was applied and take minimum times.

Length of spike and rachis

Interaction effect of organic manure and GA_3 showed significant difference on spike length of tuberose (Table 3). The longest spike (82.00 cm) was recorded from M_2G_2 and the shortest spike (70.00 cm) was obtained from M_0G_0. The result is agreed with the findings of Kabir et al. (2011) who concluded that the increased spike length was due to use of poultry litter. Length of rachis of tuberose showed significant variation due to combined effect of organic manure and GA_3 (Table 3). The maximum length of rachis at harvest (33.20 cm) was recorded from the treatment combined of M_2G_2 whereas, the minimum length of rachis at harvest (21.56 cm) was recorded from M_0G_0. Yadav (2007) reported that length of rachis was remarkably increased with organic and poultry litter application, alone and in combination. This finding is also agreement with (Sanap et al. 2000, Manisha et al. 2002, Barman and Rajni 2004, Al-Khassawreh et al. 2006, Sharma et al. 2006, Bhalla and Kumar 2008, Mayoli et al. 2009, Dogra et al. 2012 and Sarkar et al. 2014) where they reported that spike length and rachis length were increases significantly by applying GA_3 and this might be occurs because of GA_3 encourage vegetative growth, enhances the photosynthetic and metabolic activities, causing taller plant that provide taller spike and rachis.

Number of floretsspike^{-1}

Organic manures and GA_3 had no significant variation in terms of number of florets spike^{-1} of tuberose (Table 3).

Number of spike ha^{-1}

Interaction between organic manure and GA_3 showed significant variation in terms of number of spike in thousand ha^{-1} (Table 3). The maximum number of spike per hectare (350.00) was recorded from M_2G_2. The minimum number of spike per hectare (250.30) was recorded from M_0G_0.

Table 3. Influence of organic manures and gibberellic acid on floral characters of tuberose

Treatments		Flowering plant (%)	Length of spike (cm)	Length of rachis (cm)	Number of florets spike^{-1}	Number of spike ha^{-1}('000)
Organic manures	GA_3					
Control	Control: Water spray	71.00g	70.00 c	21.56g	30.00	250.30 l
	GA_3 at 100 ppm	85.67de	73.00 bc	24.66f	32.00	270.30 i
	GA_3 at 200 ppm	86.90 d	74.00 bc	27.64 de	34.00	278.60 g
	GA_3 at 300 ppm	81.00ef	72.00 bc	26.58ef	33.00	258.60 j
Cowdung 30 t ha^{-1}	Control: Water spray	80.00f	73.00 bc	26.96 e	34.00	258.30 k
	GA_3 at 100 ppm	92.00bc	75.00 bc	30.31 a-d	36.60	278.30 h
	GA_3 at 200 ppm	93.67ab	76.00 b	31.16 a-c	41.30	298.60 e
	GA_3 at 300 ppm	92.56 bc	75.00 bc	29.66 c-e	36.00	290.30 f
Poultry litter 20 t ha^{-1}	Control: Water spray	88.33 cd	75.00 bc	29.97 b-d	35.30	300.00 d
	GA_3 at 100 ppm	95.00ab	80.00 ab	32.18 ab	44.00	330.00 b
	GA_3 at 200 ppm	98.33a	82.00 a	33.20 a	45.30	350.00 a
	GA_3 at 300 ppm	93.83ab	76.00 b	31.11 a-c	43.30	310.00 c
LSD $_{(0.05)}$		4.820	2.07	2.60	---	5.35
Level of significance		*	*	*	ns	*
CV (%)		7.31	9.5	4.76	7.70	9.90

* = Significant at 5% level of probability; ns = Non-significant

Diameter and weight of single bulb

Non-significant variation was recorded due to combined effect of organic manure and GA_3 in terms of diameter of single bulb of tuberose (Table 4). Combined effect of organic manure and GA_3 varied significantly in terms of weight of single bulb of tuberose (Table 4). The maximum weight of single bulb (47.59 g) was observed in M_2G_2 whereas, the minimum weight of single bulb (35.59 g) was observed from M_0G_0.

Yield of bulb and bulblet ha^{-1}

Organic manure and GA_3 varied significantly on yield of bulb of tuberose (Table 4). The maximum yield of bulb (21.72 tha^{-1}) was observed from M_2G_2 whereas, the minimum yield of bulb (15.17 tha^{-1}) was recorded from M_0G_0.Statistically significant variation was recorded due to combined effect of organic manure and GA_3 in terms of bulblet yield (Table 4). The maximum yield of bulblet (26.95 tha^{-1}) was observed from M_2G_2 whereas, the minimum yield of bulblet (11.00 tha^{-1}) was observed from M_0G_0. Foliar application of GA_3 has effective effect to obtain early flowering and highest yield of good quality spikes and corm of gladiolus (Sudhakar and Kumar 2012, Rana et al. 2005 and Sarkar et al. 2014).

Table 4. Bulb yield attributes of tuberose as influenced by organic manures and gibberellic acid

Treatments		Diameter of single bulb(cm)	Weight of single bulb(g)	Yield of Bulb(t ha^{-1})	Yield of bulblet (t ha^{-1})
Organic manures	GA_3				
Control	Control: Water spray	3.11	35.59 g	15.17 k	11.00e
	GA_3 at 100 ppm	3.32	38.17 f	16.33 i	17.95d
	GA_3 at 200 ppm	3.43	39.69 e	17.28 g	18.67cd
	GA_3 at 300 ppm	3.21	35.95g	16.50 h	17.20 d
Cowdung 30 t ha^{-1}	Control: Water spray	3.52	38.29 f	15.78 j	19.22cd
	GA_3 at 100 ppm	3.67	42.67 d	17.28 g	22.76a-c
	GA_3 at 200 ppm	3.69	44.09 c	17.59 f	22.90a-c
	GA_3 at 300 ppm	3.67	42.56 d	18.84 d	22.60a-c
Poultry litter 20 t ha^{-1}	Control: Water spray	3.63	39.65 e	18.33 e	20.24b-d
	GA_3 at 100 ppm	3.85	46.12 b	19.33 c	22.67 ab
	GA_3 at 200 ppm	3.93	47.59 a	21.72 a	26.95a
	GA_3 at 300 ppm	3.75	44.37 c	20.43 b	24.46a-c
LSD $_{(0.05)}$		---	0.75	4.34	4.07
Level of significance		ns	*	*	*
CV (%)		2.22	4.06	11.52	12.04

* = Significant at 5% level of probability; ns = Non-significant

IV. CONCLUSION

In the growth pattern, flower and bulb yield of tuberose was affected significantly by the application of GA_3 and organic manures. Among them, poultry litter 20 tha^{-1} with 200 ppm GA_3 exhibited the meaningful result considering the morphological attributes of tuberose.

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