RESEARCH ARTICLE

EVALUATION OF ADVANCE BREEDING LINES OF TUBEROSE (*POLIANTHES TUBEROSA* L.) FOR FLOWER YIELD AND QUALITY

T. Usha Bharathi* and R.Umamaheswari

ICAR-Indian Institute of Horticultural Research, Bengaluru-89
Email: t.ushabharathi@gmail.com

Received-07.12.2018, Revised-27.12.2018

Abstract: Three advance breeding lines 1x6-1, IIHR-12 and An sel-1 were evaluated for two consecutive years along with parents, local check and commercial check for flower yield and quality parameters. Advance breeding line IIHR-12 was found to be superior with better flowering and quality parameters such as the medium tall spike (72.64 cm), longest rachis (28.06 cm), extended flowering duration (190.80 days) number of matured bud on spike (5.31), shorter intermodal length (3.39 cm), low spike weight (54.87 g). IIHR-12 with straight spike buds with pink tinge and attractive star shaped flowers were found to be suitable as cut flower. It was also found to be field tolerant to root knot nematode *Meloidogyne incognita*. Advance breeding line 1 x6-1 was found to be superior to the commercial check Arka Prajwal for traits days to opening of first floret (22.07), flowering duration (185.67), weight of flower spike (79.24g) with straight spikes and flower buds with pink tinge. AN sel-1 has recorded to be superior than the commercial check Arka Prajwal for days to opening of first floret (21.70), number of florets per spike (55.17), diameter of floret (4.69 cm), flowering duration (207.41), number of spikes per clump (5.03). The nature of spike of AN sel-1 was found to be bent with pink tinge on flower buds. The commercial check Arka Prajwal registered superior performance for the traits matured bud weight (1.80g), single flower weight (2.29g) and hundred flower weight (221.04 g).

Keywords: Tuberose, Advance breeding lines, Evaluation, Flower yield, Quality

INTRODUCTION

Tuberose (*Polianthes tuberosa* Linn.) belongs to family *Asperagaceae* is an important bulbous flowering plant originated at Mexico (Bailey, 1919). The flowers of tuberose are used as a loose flower, cut flower and perfumery industry. It is cultivated India in an area of about 16.19 ('000 ha), with a loose flower production of 107.91 ('000 MT) and cut flower production of 89.29 (Lakh Nos.) of cut stems (Anon, 2016). In India it is commercially grown in West Bengal, Tamil Nadu, Andhra Pradesh, Karnataka, Odisha, Bihar, Chhattisgarh, Haryana, Madhya Pradesh, Maharastra, Telangana and Uttarakhand. Root knot nematode problems in tuberose are wide spread in North and South India (Rao *et al.* 2001). Wider occurrence of root knot nematode in the tuberose growing subtropical and tropical regions is reported to cause 10 to14 *per cent* reduction in flower yield (Khan and Parvatha Reddy, 1992). The crop has limited genetic variability due to self-incompatibility, dichogamy and poor seed setting (Shen *et al.*, 1986) resulting in very few improved cultivars. The present study was carried out with the aim to evaluate the advance breeding lines of tuberose lines developed at ICAR-IIHR, Bangalore for flower yield and quality.

MATERIALS AND METHODS

The experiment was conducted for two years during 2016 to 2018 in the research farm of division of Floriculture and Medicinal Crops, ICAR- Indian Institute of Horticultural Research), Bengaluru, India. The experimental site was geographically located at 13^{o} 58' N Latitude, 78^{o}E Longitude and at an elevation of 890 m above mean sea level. The following tuberose lines/cultivars were evaluated for their performance along with commercial and local check.

Tuberose lines/cultivars	Parentage	Type of flower
Hybrid 1x6-1	Arka Shringar x IIHR-6	Single
IIHR-12	Open pollinated seedling selection from Arka Shringar	Single
AN sel-1	Clonal selection from Arka Nirantara	Single
Arka Prajwal	Arka Shringar x Mexican Single	Single
Arka Nirantara	Arka Shringar x IIHR-6	Single
Mexican Single	Primitive Variety	Single
Arka Shringar	Mexican Single x 'Pearl' Double	Single
IIHR-6	Mexican Single x 'Pearl' Double	Single

*Corresponding Author

The experiment was laid out in randomized block design with three replications. Uniform size of bulbs (2.5 cm) were planted on raised bed with the spacing of 30 x 30 cm. Standard cultural practices were followed throughout the experiment period. The observations were recorded for two years on days to spike emergence, days to opening of first floret, spike length, rachis length, number of flowers per spike, length of floret, diameter of floret, bud length, matured bud weight, single flower weight, flowering duration, weight of 100 florets, number of spikes per clump, weight of florets per spike, number of bulbs per clump, number of bulblets per clump, internodal length and number of matured bud at a time. The tuberose lines/cultivars were screened for the tolerence/ resistance against root knot nematode *Meloidogyne incognita* for two years. Gall Index (GI) was recorded in a 0-5 scale as per Taylor and Sasser (1978). The pooled data of two years were statistically analysed as per Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Significant differences were recorded among the tuberose lines/cultivars evaluated for flowering parameters (Table 1 and 2). Days to spike emergence ranged from 112.37 (Arka Prajwal) to 152.23 days (IIHR-6) and none of the advance breeding lines were found to be superior to commercial check Arka Prajwal for this trait. Days to opening of first floret varied from 18.24 (Arka Shringar) to 28.00 days (IIHR-6) and this trait was recorded to be earliest in Arka Shringar (18.24). Early flowering in tuberose cv. Hyderabad Single was reported by Ramachandrudu and Thangam (2009) in cv. Mexican Single.

Spike length varied from 65.77 (Arka Shringar) to 115.63 cm (IIHR-6) and the tuberose lines IIHR-6 was found to be superior to the commercial check Arka Prajwal (91.77 cm). Spike length of IIHR-12 (72.64 cm) and Arka Shringar (65.77 cm) recorded to be medium tall and lesser than Arka Prajwal. Rachis length ranged from 17.28 (Mexican Single) to 28.06 cm (IIHR-12) and the cultivar IIHR-12 was found to be superior to the commercial check Arka Prajwal (25.78 cm). Number of florets per spike varied from 42.53 (IIHR-12) to 55.17 (AN sel-1) and the cultivars AN sel-1 (55.17), Arka Nirantara (51.90) and Arka Shringar (49.33). Variation in number of florets per spike was also assessed by Ranchana *et al.* (2013) in tuberose. Rani and Singh (2005) also reported similar variation in number of florets per spike in gladiolus.

Length of the floret ranged from 5.60 (IIHR-6) to 6.30 cm (Arka Nirantara) and it was found to be superior than the commercial check Arka Prajwal (6.08 cm) in the cultivars Arka Nirantara (6.30cm), AN sel-1 (6.27 cm) and IIHR-12 (6.02 cm). Krishnamoorthy *et al.* (2014) and Singh *et al*., (2018) also reported maximum floret length in variety Arka Prajwal. Diameter of the floret was found to be superior than the commercial check Arka Prajwal (4.31 cm) in Arka Nirantara (4.71 cm), AN sel-1 (4.69 cm) and Hybrid 1x6-1 (4.35 cm).This trait ranged from 3.67 (IIHR-12) to 4.71 cm (Arka Nirantara). The results are in close conformity with the findings of Mahawer *et al.* (2013), Singh and Dekho (2017) and Singh *et al*., (2018) in tuberose. The bud length varied from 5.39 (IIHR-6) to 6.20 cm (Mexican Single) and the cultivar Mexican Single found to be superior to the commercial check Arka Prajwal (6.11 cm). Matured bud weight ranged from 0.98 (IIHR-6) to 1.80 g (Arka Prajwal) and none of the cultivar was found to be superior over commercial check Arka Prajwal. The trait single flower weight varied from 1.31 (Mexican Single) to 2.29 g (Arka Prajwa) and none of the cultivars found to be superior to the commercial check Arka Prajwal. Weight of single floret is an important trait for loose flowers as they are sold on weight basis. Variation in weight of single floret might be due to the genetic makeup of the cultivars under study and similar observations were made by Ramachandrudu and Thangam (2009) in tuberose cultivar Arka Prajwal.

Flowering duration varied from 144.96 (IIHR-6) to 207.73 days (Arka Nirantara) and the cultivars Hybrid 1x6-1 (185.67), IIHR-12 (190.80), AN sel-1 (207.4) were found to be superior than the commercial check Arka Prajwal (181.88 days). Weight of hundred florets ranged from 119.53 (Mexican Single) to 221.04 g (Arka Prajwal) and none of the cultivars were found to be superior to the commercial check Arka Prajwal. The highest yield registered by Arka Prajwal might be due to its capacity to produce more number of flowers per spike and weight of florets per spike. The results are in corroborates with the findings of Krishnamoorthy *et al.* (2014), Vijayalaxmi and Lakshmidevamma (2016) in tuberose.

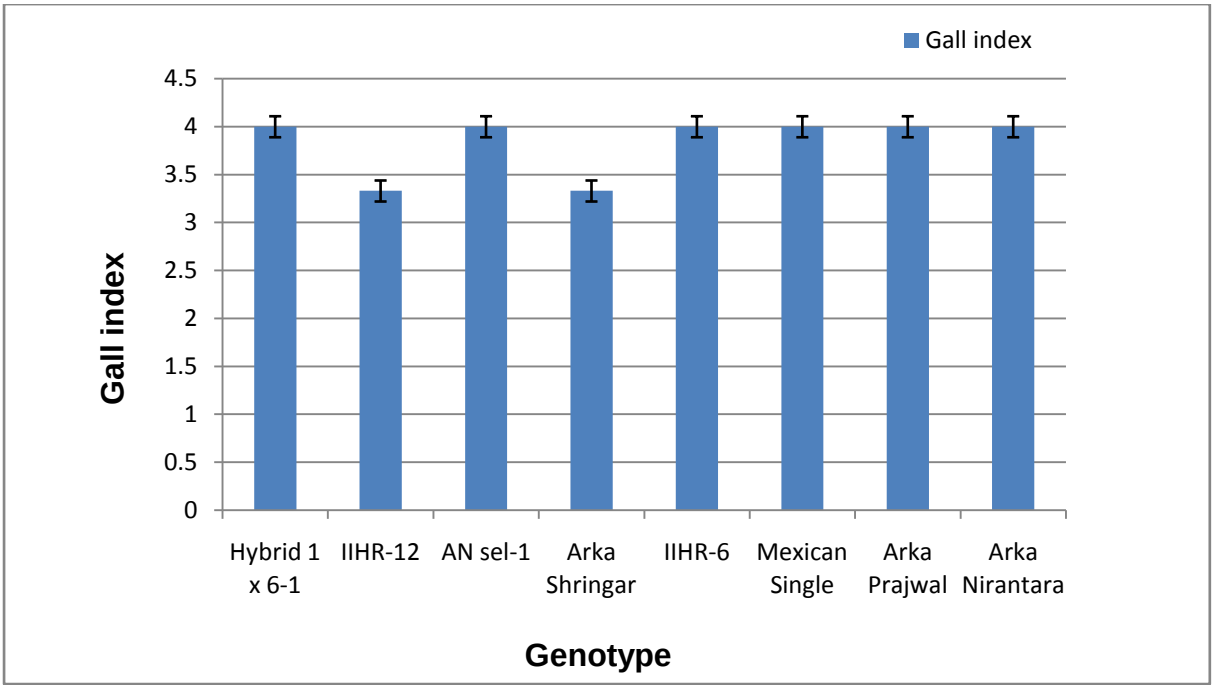
Number of spikes per clump varied from 2.07 (IIHR-6) to 5.41 (Arka Nirantara) and the cultivars Arka Nirantara (5.41) and AN sel-1 (5.03) were found to be superior than the commercial check Arka Prajwal. This variation in the production of spikes per clump might be due to the extended flowering duration, inherent genetic factor of different cultivars under prevailing environment condition. This variation in spikes per clump is in accordance with the findings of Martolia and Srivastava (2012) and Krishnamoorthy *et al.* (2014) in tuberose cv. Arka Prajwal.

The trait weight of florets per spike ranged from 43.37 (Mexican Single) to 79.24 g (Hybrid 1 x6-1) and the cultivar Hybrid 1 x 6-1 (79.24g) was found to be superior than the commercial check Arka Prajwal. The lesser spike weight is ideal for transportation of whole spike for cut flower purpose and the tuberose cultivars IIHR-12 (54.87 g), IIHR-6 (45.70 g) and Arka Shringar (43.45 g) registered lesser spike weight. Number of bulbs per clump varied from 2.92 (IIHR-12) to 8.25 (Arka Prajwal) and none of the cultivars were found to be superior than the commercial check Arka Prajwal. Similar observations were recorded by Martolia and Srivastava (2012) in tuberose.

The trait intermodal length indicates compactness of the florets arranged on rachis, which is ideal for cut flower. This trait varied from 3.39 (IIHR-12) to 5.65 cm (IIHR-6) and the cultivars IIHR-6 was found to be superior to the commercial check Arka Prajwal (5.24 cm). The tuberose cultivars IIHR-12 (Plate 1) recorded with shorter internodal length of 3.39 cm as like parent Arka Shringar (3.41 cm). Number of matured bud in spike depicts number of florets open at a time on spike which is the essential criteria for cut flower. This trait ranged from 2.05 (Mexican Single) to 5.31 (IIHR-12) and the cultivar IIHR-12 was found to be superior to the commercial check Arka Prajwal (3.20). Nature of spike of the cultivars Arka Prajwal, Hybrid 1 x6-1, IIHR-12, Arka Shringar were found to be straight. The nature of spike of cultivars Mexican Single and IIHR-6 were found to be slight bent and the cultivars Arka Nirantara and AN sel-1 were found to be bent. The tinge on flower bud wad recorded to be pink on all the tuberose cultivars under study except Mexican Single which was green in colour. The type of flower opening was found to be wide in all the cultivars except IIHR-12 which was shy opener with star shaped flowers. The tuberose lines and cultivars were screened for tolerance/resistance to root knort nematode (Fig 1). Among the lines/cultivars screened IIHR-12 and Arka Shringar are found to be tolerant to root knot nematode *Meloidogyne incognita*.

Plate 1. Advance breeding line of tuberose IIHR-12

Fig 1. Reaction of tuberose cultivars to root knot nematode



Gall index: 0-Immune, 1 - Highly resistant, 2 - Resistant, 3- Tolerant, 4- Susceptible, 5 - Highly Susceptible

Table 1. Flowering parameters of advance breeding lines of tuberose for the two years (2016-17 and 2017-18)

Genotype	Days to spike emergence	Days to opening of 1st floret	Spike length (cm)	Rachis length (cm)	Number of florets per spike	Length of Floret (cm)	Diameter of floret (cm)	Bud length (cm)	Matured bud weight (g)	Single flower weight (g)	Flowering duration (days)
Hybrid 1 x 6-1	114.07	22.07*	83.18	24.91	49.47	5.74	4.35	6.08	1.77	2.12	185.67*
IIHR-12	148.30	19.77*	72.64	28.06*	42.53	6.02	3.67	6.06	1.40	1.71	190.80*
AN sel-1	121.53	21.70*	89.48	23.40	55.17*	6.27	4.69*	5.98	1.21	1.58	207.41*
Arka Shringar	136.03	18.24*	65.77	19.77	49.33*	5.68	4.32	5.49	1.03	1.31	152.76
IIHR-6	152.53	28.00	115.93*	20.60	46.10	5.60	4.06	5.39	0.98	1.35	144.96
Mexican Single	130.60	20.30*	90.70	17.28	46.53	5.82	4.20	6.20*	0.98	1.20	160.44
Arka Prajwal	112.37	27.57	91.77	25.78	49.20	6.08	4.31	6.11	1.80	2.29	181.88
Arka Nirantara	117.80	21.70*	79.55	20.54	51.90*	6.30*	4.71*	6.08	1.26	1.54	207.73*
Mean	129.15	22.42	86.13	22.54	48.78	5.94	4.29	5.92	1.30	1.64	178.96
Range	112.37 - 152.53	18.24-27.57	65.77-115.93	17.28-28.06	42.53-55.17	5.60 - 6.30	3.67 - 4.71	5.39 - 6.20	0.98 - 1.80	1.31 - 2.29	144.96 - 207.73
CD(P=0.05)	4.89	1.91	5.07	2.46	4.00	0.45	0.22	0.20	0.16	0.22	9.05
CV %	2.16	4.86	3.36	6.24	4.69	4.35	2.99	1.94	6.77	7.54	2.89

* Superior than commercial check Arka Prajwal

Table 2. Flower yield and bulb parameters of advance breeding lines of tuberose for two years (2016-17 and 2017-18)

Genotype	Weight of hundred florets (g)	Number of spikes per clump	Weight of spike (g)	Number of bulbs per clump	Number of bulblets per clump	Internodal length (cm)	Number of matured bud at a time	Nature of spike	Tinge on flower bud	Type of flower opening
Hybrid 1 x 6-1	202.13	3.81	79.24*	3.92	35.50	4.80	3.73	Straight	Pink	Wide

IIHR-12	171.24	3.89	54.87	2.92	28.33	3.39	5.31*	Straight	Pink	Shy
AN sel-1	158.58	5.03*	64.75	7.00	38.08	4.51	2.32	Bent	Pink	Wide
Arka Shringar	134.31	3.40	43.45	3.92	40.92	3.41	2.12	Straight	Pink	Wide
IIHR-6	132.12	2.07	45.70	3.92	40.33	5.65*	2.95	Slight bent	Pink	Wide
Mexican Single	119.53	3.88	43.37	7.50	49.92	5.08	2.05	Slight bent	Green	Wide
Arka Prajwal	221.04	4.98	78.19	8.25	36.08	5.24	3.20	Straight	Pink	Wide
Arka Nirantara	153.57	5.41*	59.88	6.00	28.08	4.41	2.22	Bent	Pink	Wide
Mean	161.57	4.06	58.68	5.43	37.16	4.56	2.99	-	-	-
Range	119.53 - 221.04	2.07 - 5.41	43.37 - 79.24	2.92 - 8.25	28.33 - 49.92	3.39 - 5.65	2.05 - 5.31	-	-	-
CD(P=0.05)	11.37	0.34	11.57	1.32	NS	0.74	0.61	-	-	-
CV %	4.02	4.71	11.26	13.84	-	9.27	11.64	-	-	-

* Superior than commercial check Arka Prajwal

CONCLUSION

Among the cultivars evaluated for flowering and yield parameters, IIHR-12 with superior flowering and quality parameters such as the medium tall spike, longest rachis, more number of matured bud on spike, shorter intermodal length with compact flower arrangement were found to be suitable as cut flower. The low spike weight with straight spikes, buds with pink tinge and attractive novel star shaped flowers of IIHR-12 were also found to be ideal for cut flower. It was also found to be field tolerant to root knot nematode *Meloidogyne incognita*.

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