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Naveen Kumar BS
Department of Vegetable
Science, IGKV, Raipur,
Chhattisgarh, India

Dr. Veere Gowda R
Principle scientist,
ICAR-IIHR Bengaluru,
Karnataka, India

Dr. Rajshree Gayen,
Department of Vegetable
Science, IGKV, Raipur,
Chhattisgarh, India

Corresponding Author:
Naveen Kumar BS
Department of Vegetable
Science, IGKV, Raipur,
Chhattisgarh, India

Morphological characterisation of male sterile lines in white onion [*Allium cepa* L.]

Naveen Kumar BS, Dr. Veere Gowda R and Dr. Rajshree Gayen

Abstract

The present investigation on “Morphological characterization of male sterile lines in white onion” (*Allium cepa* L.)” was carried out at the Division of Vegetable crops, Indian Institute of Horticultural Research (IIHR), Bengaluru. The experimental site had red clay loam soil and is located at 13° 58' north longitude 78° 37' east and an altitude of 890 meters above mean sea level. The genotypes used in this study were maintained at the Division of Vegetable crops, Indian Institute of Horticultural Research (IIHR), Bengaluru.

The experiment was carried out with 10 genotypes namely PW0-18, TW-18, PWR-18, RW-18, AW-O-18. Male sterile lines and their respective fertile lines of 5 genotypes are morphologically characterized for the growth and seed yield related characters. Among the observations taken in seed crop PWR-18 MF recorded highest number of seeds per umbel (61.70), highest number of flowers per umbel were observed in PWR-18 MS (260.93), TW-18 MS recorded highest length of umbel (5.80 cm), AWO-18 recorded highest number of leaves (6.46) seed yield were observed maximum in PWR-18 and performed well in both growth and seed yield related characters.

Keywords: Onion, genotypes, characterised, sterile

Introduction

The onion plants are characterized by bluish green distichous leaves. The bulbs contain short compressed underground stems surrounded by fleshy modified scale that covers a central bud at the end of the stem. The sheath part of the leaves forms a pseudo stem, which hides a great part of the above ground scape. The growth of flower stalk ceases when umbels initiates to flower. The length of scape (flower stalk/seed stem) is maintained by genetic factors, long stalks (Dwl) being dominant over dwarf, (dwl) stalk (Fritsch and Friesen, 2002) [17]. Onion umbels are spherical in shape, which consists of 50 to 2000 flowers, common range being 200-600 in much of the flowers. Heterozygous plants produce much flowers compared to inbred plants. The growth of flowering stalk is stopped when umbels starts flowering each flower is attached to a slender pedicel. The flower stalk of onion reaches to a final length of 1-2m. Onion flowers contains nectarines, which helps to attract insects for cross-pollination. Honey bee acts as a major pollinator. Honey bee hives are used for pollination. Anthers shed pollen over a period of 3-4 days prior to the time when full length of style is attained.

Material and Methods

The present investigation on “Identification of male sterile lines in white onion” (*Allium cepa* L.)” was carried out at the Division of Vegetable crops, Indian Institute of Horticultural Research (IIHR), Bengaluru. The experimental site had red clay loam soil and is located at 13° 58' north longitude 78° 37' east and an altitude of 890 meters above mean sea level.

Bulb Planting

The bulbs were planted in pots. Uniform healthy true to type bulbs were selected Three bulbs per pot were planted. Top one-third portion of the bulbs were cut and fungicide (Blitox) paste was applied to the cut ends before planting Bulbs were drenched with captaf at the rate of 2g per litre of water immediately. Regular plant protection measures were followed to control pests and diseases.

Earthing up

Earthing up was done manually at 30 DAP before top dressing of urea.

Irrigation

Irrigation was given frequently through drip irrigation.

Plant Protection measures

Drenching of plants was done by using captan and thiram @0.2% Spraying of Acephate, kavach (0.5 ml liter-1of water) was done to control thrips at 45 DAP and 60 DAP.

Harvesting of umbels and processing of seeds

The umbels were harvested when they were mature and showed the signs of shattering. All the harvested umbels were packed in bags according to different treatments separately. The umbels were dried in sun and seeds were extracted from each umbel which were later processed to get good seeds and packed in separate bags

Result and Discussion**Morphological characterization of male sterile lines**

The different morphological and floral characterization of male sterile and fertile lines are presented in table 4.2 and 4.5.

Plant height (cm)

Significant differences were obtained for plant height. Highest plant height (57.33 cm) was recorded in AW-O-18 MS followed by (54.25 cm) for PWR-18 MS among sterile lines. In fertile lines, PWR-18 MF recorded highest plant height (57.81 cm) followed by RW-18 MF (54.29cm). Lowest plant height was recorded by TW-18 MS (44.84 cm) followed by PWO-18 MS (47.97 cm) among sterile lines. Among fertile lines PWO-18 MF (44.64 cm) recorded lowest plant height followed by AW-10-18 MF (46.62 cm).

Number of leaves

Among the genotypes significant differences were obtained for number of leaves. The highest number of leaves was recorded in AW-O-18 MS (6.46) followed by (6.3) for PWR-18 MS among sterile lines. In fertile lines, the highest number of leaves recorded for PWR-18 MF (6.16) followed by AW-O-18 MF (6.16). Lowest number of leaves was recorded by RW-18 MS (5.16) followed by TW-18 MS (5.36) among sterile lines. Among fertile lines PWO-18 MF (5.13) recorded lowest number of leaves followed by RW-18 MF (5.70)

Leaf length (cm)

The highest leaf length was recorded PWR-18 MS (53.86 cm) followed by AW-O-18 MS (48.66 cm) among sterile lines. The fertile line AW-O-18 MF recorded maximum leaf length (52.13 cm) followed by PWR-18 MF (51.13cm) among fertile lines. Lowest leaf length was recorded by PWO-18-MS (38.46 cm) followed by TW-18 MS (45.66 cm) among sterile lines. Among fertile lines PWO-18 MF (43.40 cm) followed by TW-18 MF (47.50 cm) among fertile lines.

Leaf width (cm)

The highest leaf width was recorded by RW-18 MS (1.28cm) followed by PWR-18 MS (0.95 cm) among sterile lines. In fertile line highest leaf width was recorded in PWR-18 MS (1.2 cm) followed by RW-18 MF (0.73 cm) among fertile lines. Lowest leaf width was recorded by PWO-18 MS (0.65 cm) followed by TW-18 MS (0.67cm) among sterilelines. Among fertile line TW-18 MF (0.66 cm) followed by PWO-18 MF (0.71 among fertile lines

Number of days for flowering

Early flowering was observed in AW-O-18 MS (69.1) followed by RW-18 MS (75.7) among sterile lines and TW-18 MF (65.06) had early flowering followed by RW-18 MF (66.73) among fertile line. Late flowering was observed in TW-18 MS (78.33) followed by PWR-18 MS (78.00) among sterile lines. Among fertile lines PWR-18 MF (78.83) had late flowering followed by TW-18 MS (78.33)

Height of flower stalks per plant (cm)

Significantly highest number of flower stalks per plant was recorded for PWR-18 MS (65.73 cm) followed by RW-18 MS (60.68cm) among sterile lines. The fertile line PWR-18 MF (65.47 cm) recorded highest value followed by AW-O-18 MF (59.10 cm) in fertile lines. Lowest height of flower stalk was observed in TW-18 MS (47.50 cm) followed by RW-18 MS (49.00) among sterile lines. Among fertile lines lowest height of flower stalk was recorded by RW-18 MF (47.10 cm) followed by PWO-18-MF (51.35 cm) among fertile lines.

Number of flower stalks per plant

Among sterile lines PWR-18 MS (5) recorded highest number of flower stalks. Among fertile lines RW-18 MF recorded highest (5). Rest of the sterile and fertile line are having similar number of flower stalk i.e 4

Length of umbel (cm)

Among sterile lines TW-18 MS (5.8cm) recorded highest length of umbel followed by PWR-18 MS (5.73cm). Among fertile lines PWR-18 MF recorded highest length of umbel (5.78 cm) followed by PWO-18 MF (5.28 cm). Lowest length of umbel was recorded by PWO-18 MS (4.06 cm) followed by RW-18 MS (44.33 cm) among sterile lines. Among fertile lines TW-18 MF (4.26 cm) recorded lowest length of umbel followed by RW-18 MF (4.27 cm)

Width of umbel (cm)

Highest width of umbel was recorded in PWR-18 MS (6.23 cm) followed by TW-18 MS (5.90) among sterile lines. Among fertile lines highest width of umbel was recorded in PWR-18 MF (6.37 cm) followed by PWO-18 MF (5.85 cm). Lowest width of umbel was recorded in RW-18 MS (4.26 cm) followed by AW-O-18 MS (5.43 cm) among sterile lines. Among fertile lines RW-18 MF (4.26 cm) recorded lowest width of umbel followed by TW-18 MF (4.87 cm)

Number of seeds per umbel

Among the test genotypes significant differences were obtained for number of seeds per umbel. No seeds were observed in sterile umbels. In fertile lines PWR-18 MS (61.7) recorded highest followed by AW-O-18 MF (46.44). Lowest number of seeds per umbel was recorded in RW-18 MF (28.06) among fertile lines

Number of flowers per umbel

Among the test genotypes significant differences were obtained for number of flowers per umbel. The highest number of flowers per umbel recorded for PWR-18 MS (260.93) followed by PWO-18 MS (258) among sterile lines. In fertile lines PWO-18 MF recorded highest number of flowers per umbel (250.66) followed by TW-18 MF (225.86). Lowest number of flowers per umbel was recorded in AW-O-

18 MS (148.97) followed by RW-18 MS (214.86) among sterile lines. Among fertile lines RW-18 MF (167.45) had lowest number of flowers followed by PWR-18 MF (214.86)

Number of seeds per locule

Among the test genotypes significant differences were obtained for number of seeds per locule. In sterile lines there was no seeds in locule. In fertile lines PWR-18 MF recorded highest number of seeds (5.83) followed by RW-O-18 MF (5.56). Lowest seeds per locule was observed in PWO-18 MF (3.53) among fertile lines

Weight of seeds per umbel (g)

Significant differences for weight of seeds per umbel were noticed among the genotypes. No seed set was observed in sterile seeds. In fertile lines PWR-18 MF (1.22g) recorded highest weight of seeds followed by AW-O-18 MF (1.14 g). Lowest weight of seeds per umbel was recorded in RW-18 MS (0.56) among fertile lines

Seed yield per plant (g)

Seeds were not formed in sterile umbels. Among fertile lines PWR-18 MF recorded highest seed yield per plant (5.66 g) followed by AW-O-18 MF (4.52 g). Lowest seed yield was obtained by PWO-18 MF (2.48)

Discussion

Among the genotypes the yield of seed has significant genotypic and phenotypic association with flower stalk height per plant, number flowers per umbel, umbel diameter and weight of 1000 seeds (Mohanty, 2002)^[39].

Growth characters

Significantly the highest and lowest plant height was recorded by AW-O-18 (57.33 cm) and TW-18 (44.84 cm), respectively. Among fertile lines, PWR-18 (57.81cm) recorded highest and PWO-18 (44.64cm) recorded lowest plant height. Earlier Sandhu and Korla (1975)^[40] reported similar results in onion. The sterile lines AW-O-18(6.46cm) recorded highest and RW-18 (5.16cm) recorded lowest number of leaves. In fertile lines, the highest number of leaves was recorded in Pusa white round (6.16 cm) and the lowest in PWO-18 (5.13 cm) respectively. Similar results were obtained by Dadlani and Bhagchandani (1988)^[9]. AW-O-18 MS and MF and PWR-18 MS and MF performed well for vegetative growth characters. Both length and width of umbels differed significantly among test genotypes. Among sterile genotypes highest length was recorded in TW-18 (5.9 cm) and lowest was recorded in RW-18 (4.33 cm). The fertile genotypes PWR-18 (5.78 cm) and AW-O-18 (5.32 cm) recorded the highest and lowest values respectively.

Significantly the highest width of umbel was recorded in PWR-18 (6.23 cm) and lowest in AW-O-18 (5.43 cm) in sterile genotypes. Among fertile genotypes, PWR-18 (6.23 cm) recorded the highest and RW-18 (4.26 cm) recorded lowest width of umbel. Similar results were obtained by

Dadlani and Bhagchandani (1988)^[9] in onion. It is concluded that genotypes of different groups showed significant variation for growth, development, flowering and seed characteristics. It showed that the genetic factor is determinative in the characterization of each material. PWR-18 and AWO-18 were found to have more length and width of umbels

Flowering and related characters

Seed yield had a high, significant correlation with height of flower stalks per plant, number of seeds and flowers per umbel and umbel size. (Aklilu *et al.*, 2001). In present study significantly highest height of flower stalks per plant was recorded in line PWR-18 (65.73cm) and the lowest in TW-18 (47.5cm). Among fertile lines PWR-18 (65.47cm) and RW-18 (47.10cm) recorded the highest and lowest number of flower stalks per plant respectively. Plant density might have contributed for number of flower stalks per plant as reported by Dadlani and Bhagchandani (1988)^[9]. Number of flowers per umbel differed significantly between lines. The highest number of flowers per umbel recorded in PWR-18 (260.93cm) and the lowest in AW-O-18 (148.97cm). Among fertile lines, PWO-18 (250.66 cm) and AW-O-18 (250.66 cm) recorded highest and lowest number of flowers per umbel. The difference in number of flowers per umbel may be attributed to varietal character. Similar significant differences were also reported by Popandron (1998)^[30] in onion. AW-O-18 MS and MF followed by PWR-18 showed highest performance for flowering and yield related character

Seed yield and related characters

Number of seeds and flowers per umbel and size of umbel had significant correlation with seed yield as reported by Aklilu *et al.*, (2001). There was no seed set in sterile lines due to sterile pollen. Among fertile lines it varied significantly, the highest number of seeds per umbel was recorded in PWR-18 (61.70) and the lowest in RW-18 (25.06) Among sterile lines PWR-18 (260.93) recorded highest and AW-O-18 (148.97) recorded lowest number of flowers per umbel. The character namely seeds per umbel and seeds per locule depends on per cent seed set in turn per cent seed was influenced by the fertilization, availability of pollen and abortion of embryo after germination may contribute to these characters. Similar results were obtained by Dadlani and Bhagchandani (1988)^[9]. Significant differences for seed yield per plant were noticed among the lines. The fertile lines, PWR-18 (5.66 g) and AW-O-18 (4.52 g) recorded highest and lowest seed yield per plant respectively. Seed yield manifested positive and significant genotypic and phenotypic association with number of seed stalks per plant, flowers per umbel, diameter of umbel and 1000 seed weight. (Mohanty, 2002)^[39]. Similar results were obtained by Dadlani and Bhagchandani (1988)^[9] in onion seed crop. PWR-18 and AWO-18 gave higher seed yield and performed well for seed yield related characters

Table 1: Morphological characterization of male sterile lines and fertile lines of seed crop for Growth related parameters

Genotype	Plant height (cm)	Number of leaves (cm)	Leaf length (cm)	Leaf Width (cm)	Number of days for flowering	Height of flower stalk (cm)	Number of flower stalks/plant	Width of umbel (cm)
PWO-18 MS*	47.97	5.50	38.46	0.65	76.93	50.54	4	5.51
PWO-18 MF*	44.64	5.13	43.40	0.71	76.00	51.35	4	5.85
TW-18 MS*	44.84	5.36	45.66	0.67	78.33	47.50	4	5.90

TW-18 MF*	47.00	5.83	47.50	0.66	65.06	52.82	4	4.87
PWR-18 MS*	54.25	6.30	53.86	0.95	78.00	65.73	5	6.23
PWR-18 MF*	57.81	6.16	51.13	1.20	78.83	65.47	4	6.37
RW-18MS *	48.32	5.16	46.13	1.28	75.77	49.00	4	4.26
RW-18 MF*	54.29	5.70	47.83	0.73	66.43	47.10	5	4.26
AW-O-18 MS*	57.33	6.46	48.66	0.80	69.11	60.68	4	5.43
AW-O-18 MF*	46.62	5.96	52.12	0.71	66.73	59.10	4	5.45
Mean	50.30	5.756	47.47	0.83	73.11	54.92	4.24	5.41
CD@5%	5.50	0.68	5.12	0.23	4.78	3.89	0.12	0.34
SE(M)	1.83	0.22	1.71	0.07	1.59	1.30	0.25	0.11
CV@%	6.32	6.85	6.24	15.99	3.7	4.10	10.17	3.69

*MS-Male sterile

*MF-Male fertile

Table 2: Morphological characterization of male sterile lines and fertile lines of seed crop for seed yield related parameters

Genotypes	Length of umbel(cm)	Number of flowers/umbel	Weight of seeds/ umbel (g)	Number of seeds / locule(cm)	Number of seeds / umbel(cm)	Seed yield /plant (g)
PWO-18 MS*	4.06	258.00	0	0	0	0
PWO-18 MF*	5.40	250.66	0.63	3.53	36.03	2.48
TW-18 MS*	5.80	220.83	0	0	0	0
TW-18 MF*	4.26	225.86	0.74	4.44	31.70	2.75
PWR-18 MS*	5.73	260.93	0	0	0	0
PWR-18 MF*	5.78	198.48	1.22	5.83	61.70	5.66
RW-18 MS*	4.33	214.86	0	0	0	0
RW-18 MF*	4.27	167.45	0.56	4.30	25.06	2.77
AW-O-18 MS*	5.18	148.97	0	0	0	0
AW-O-18 MF*	5.32	209.80	1.14	5.56	46.44	4.52
Mean	5.01	215.58	0.42	2.36	20.09	1.81
CD@5%	0.43	9.49	0.08	0.50	2.01	0.13
SE(M)	0.14	3.17	0.02	0.16	0.67	0.46
CV@%	5.01	2.54	10.69	12.39	5.78	4.34

*MS-Male sterile

*MF-Male fertile

Conclusions

1. There was no seed set in sterile lines
2. PWO-18 was a dominant performance among the genotypes followed by AW-O-18

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