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Performance of 'great headed garlic' (*Allium ampeloprassum* L. var. *ampeloprassum*) genotype IC 0598236 as affected by seed clove type and planting distance under temperate hills conditions

A.C. Mishra* and Vivek Pandey

Department of Vegetable Science, Veer Chandra Singh Garhwali Uttarakhand University of Horticulture and Forestry, Ranichauri Campus, Tehri-Garhwal 249 199, Uttarakhand

ABSTRACT

The present investigation was carried out on a new *allium* crop 'great headed garlic' (*Allium ampeloprassum* L. var. *ampeloprassum*) genotype IC-0598236 developed at Department of Vegetable Science, VCSGUH&F, Ranichauri, Tehri-Garhwal. The treatments included two factors, first types of seed cloves (A), *viz.*, miniature seed cloves (A_1), each weighing 1.0-1.5 g and obtained from planting the seedlings raised from micro-cloves produced in terminal umbels and the commercial seed cloves (A_2), each weighing 6.0-6.5 g and obtained from underground bulbs of commercial crop. The second factor included four planting distances (B), *viz.*, 15 × 7.5 cm (B_1), 15 × 10 cm (B_2), 20 × 7.5 cm (B_3) and 20 × 10 cm (B_4). The results of the experiment indicated that miniature seed cloves and big sized commercial seed cloves had significant influence on bulb yield and vegetative growth. Significantly higher bulb yield was recorded in the crop raised from commercial seed cloves (232.23 q/ha). However, the bulbs produced from miniature seed cloves were more compact and thus likely to have more storability as these had higher specific gravity value (1.16 g/cm^3). The planting geometry including medium distance (20 × 7.5 cm and 15 × 10 cm) was found to have higher bulb yield (231.23 and 228.00 q/ha, respectively) with an increase by 4.86-6.35% as compared to close planting distance of 15 cm × 7.5 cm (217.43 q/ha) and 8.85-10.39% as compared to wider planting distance of 20 cm × 10 cm (209.46 q/ha). The combination of commercial seed cloves and closest planting distance (15 cm × 7.5 cm) was found to have highest bulb yield (248.21 q/ha).

Key words: *Allium ampeloprassum* L. var. *ampeloprassum*, Great headed garlic, clove type, planting distance.

INTRODUCTION

Some *Allium* sp. having unique features of producing umbels consisting of numerous bulbils identical to small cloves have been identified as *A. ampeloprasum* (Bohanec *et al*., 6; Hirscheggar *et al.,* 9) but all the varieties of *A. ampeloprasum* essentially did not have bulbils (Block, 5). The great headed garlic or elephant garlic or levant garlic (*Allium ampeloprassum* L. var. *ampeloprassum*) has been identified as an *allium* species producing umbels of small cloves like *A. ampeloprasum* and also underground bulbs with outer small cloves and inner larger ones (Brewster, 7). The great headed garlic is a new crop for temperate hills of India. Even, there is no obvious evidence of occurrence or cultivation of this crop in South-western England and France (Bohanec *et al*., 6), the regions of its origin. No systematic records of documentation in relation to morphological characterization, biochemical and physico-chemical parameters, available genetic resources and cultivation practices are available in India or abroad. In mid- to higher hills (2,000-2,500 m) of Uttarakhand, this species occurs as admixture in landraces of common garlic (*A. sativum* L.). The great headed garlic belongs to the family Alliaceae and resembles to common garlic in morphology and taste. A genetic stock of this crop, *i.e.* IC 0598236 has been clonally propagated and evaluated for different morphological, physico-chemical and yield parameters in the Department of Vegetable Science, VCSGUH&F, Ranichauri Campus, Tehri-Garhwal. The genetic material IC 0598236 has unique feature of producing big size of bulbs weighing 70-75 g comprising 10-12 cloves of 6-8 g each. Plants are foliaceous, leaves dark green, flattened and leathery measuring about 46.0 cm in length and 2.8 cm in width. The leaves, bulbs and cloves of great headed garlic (*A. ampeloprasum* L. var. *ampeloprasum*) were larger than those of common garlic (*A. sativum*) due to tetrapoid genome in the former (Figliuolo and DiStefano, 8). The central growing portion of shoot in great headed garlic develops into flowering stalks bearing pink coloured terminal umbel at crop maturity during spring-summer. The umbels consist of tiny anthers arising from the base of ovaries turned in to micro-cloves (bulbils in the case of common garlic) by virtue of storage of food materials. Thus, the reproductive system in flowers is not conspicuous and functional. The micro-cloves have meristematic tissues differentiating into roots

*Corresponding author's E-mail: acm24680@gmail.com

and shoots. Each umbel consists of about 150-175 micro-cloves. One gram weight comprise of 28-32 micro-cloves. The viability of micro-cloves ranges from 10-12 months in ideal storage conditions. The micro-cloves could be used for raising seedlings in nursery beds and consequent upon transplanting these seedlings, miniature bulbs weighing 10-15 g with 8-10 cloves could be produced. The cloves from miniature bulbs (miniature cloves) also could be used as planting material for raising commercial crop in subsequent year. Furthermore, for commercialization of this crop, standardization of agronomic practices, *viz*., seed rate, planting time and distance, fertilizer and irrigation requirement *etc.* are necessary for hilly areas.

MATERIALS AND METHODS

The experiment was conducted at Vegetable Research Block of Veer Chandra Singh Garhwali Uttarakhand University of Horticulture and Forestry, Ranichauri Campus, Tehri-Garhwal, Uttarakhand (2,000 m altitude, 78°24' E longitude and 30°18' N latitude) during *Rabi* 2013-15. The experimental material included a new crop great headed garlic (*Allium ampeloprasum* L. var. *ampeloprasum*) genotype IC 0598236, which has ability to produce underground bulb like common garlic (*A. sativum*) and terminal umbel like onion (*A. cepa*) consisting of a large number of micro-cloves. Bulbs have big size cloves (commercial cloves) weighing 6.0-6.5 g in weight and 10-12 in number. The micro-cloves harvested from the umbels were used to raise seedlings on September 08, 2013 and these seedlings were transplanted in the field on November 03, 2013 at spacing of 10 cm x 10 cm. The crop reached to harvestable maturity in the last week of May, 2014. The seedling grown crop exhibited 65.0-74.0 q/ha bulb yield with bulbs of 10-15 g weight having 8-10 miniature cloves (each weighing 1.0-1.5 g) in each. In this way, two types of seed cloves (A), first one miniature cloves from seedling grown crop (A_1) and second commercial cloves from underground bulbs from commercial crops (A_2) were used as planting materials during October, 2014. Each type of seed cloves were planted at four spacings (B) *viz*., 15 × 7.5 cm (B_1), 15 × 10 cm (B_2), 20 × 7.5 cm (B_3) and 20 × 10 cm (B_4) in Factorial RBD with five replications in plots of 2.0 m × 1.8 m size by using seed rate of 5.5-7.5 q/ha for commercial cloves and 1.8-2.5 q/ha for miniature cloves. Manures a (20.0 t/ha FYM) and fertilizers (160:100:80 kg NPK/ha) were applied to raise a healthy crop in all treatments. The data were recorded on different plant growth and bulb yield characters as specified in Table 1.

RESULTS AND DISCUSSION

Analysis of the data exhibited that the types of seed clove and planting distance had significant individual as well as combined influence on the performance of great headed garlic crop in relation to plant growth and bulb yield traits were studied (Table 1). As far as plant growth characters were concerned, types of seed cloves had significant effect upon them. Significantly superior bulb yield was recorded in the crop grown with commercial cloves (232.23 q/ha) as compared to miniature cloves (210.83 q/ha). The crops raised from commercial cloves was also significantly superior in respect of leaf length (58.15 cm), leaf width (3.15 cm) and shoot girth (7.16 cm). However, significantly higher plant height was noted in the crop grown from miniature cloves (84.43 cm). The better performance of the crops raised from bigger sized commercial seed cloves in relation to plant growth and bulb yield was probably due to initial advantage of reserved food in germination and initiation of physiological activities for plant growth and development. Corresponding results on higher bulb yield by using bigger seed cloves have also been reported by Alam *et al.* (1), Mahmud *et al.* (10) and Alam *et al.* (3) in garlic (*A. sativum*). Among the bulb yield contributing traits, the values for bulb weight and specific gravity were noted higher in the crop raised by using miniature seed cloves although the difference with that grown with commercial seed cloves was non-significant. It indicated that the bulbs obtained from miniature seed cloves were more compact, which eventually could be expected to have more keeping quality as compared to those obtained from commercial seed cloves. Moreover, by the use of miniature seed cloves (1.5-1.8 q/ha), seed rate could be reduced by one fourth as compared to commercial seed cloves (6.0-6.5 q/ha).

The planting distance exhibited non-significant difference in relation to number of cloves per bulb, bulb weight, bulb diameter, shoot girth and leaf width. However, significant differences were noticed for bulb yield, specific gravity of bulbs, bulb volume, plant height and leaf length. Significant influence of plant spacing on bulb yield and many plant growth characters has also been reported by Alam *et al.* (2) in garlic. Maximum bulb yield was recorded in 20 × 7.5 cm spacing (231.23 q/ha) followed by that in 15 × 10 cm (228.00 q/ha), whereas, minimum bulb yield was realized under widest spacing of 20 × 10 cm (209.46 q/ha). It indicated that closer planting distance lead to higher bulb yield probably because of accommodating more number of plants in unit area (Anwar *et al.*, 4). Strengthening the results of present investigation, higher bulb yield (16.21 t/ha) in closer planting geometry (10 × 10 cm) has also been reported

Table 1. Performance of great headed garlic as affected by seed cloves and planting distance during *Rabi* 2014-15.

Treatment Seed clove (A)	Leaf length (cm)	Leaf width (cm)	Shoot girth (cm)	Plant height (cm)	Bulb dia. (mm)	Bulb wt. (g)	Bulb vol. (cm^3)	Sp. gr. of bulb ($g/cm^{3)}$	No. of cloves per bulb	Bulb yield (q/ha)
Miniature clove (A_1)	56.45	2.28	6.18	84.43	46.41	48.34	47.80	1.16	12.26	210.83
Commercial clove (A_2)	58.15	3.15	7.16	74.87	48.61	47.78	54.55	0.94	11.82	232.23
$CD_{(0.05)}$ A	1.27	0.15	0.33	2.98	3.03 NS	4.26 NS	8.25 NS	0.26 NS	0.63 NS	17.57
Spacing (B)										
15 × 7.5 cm (B_1)	59.63	2.73	6.73	76.20	45.16	48.93	41.70	1.40	11.74	217.43
15 × 10 cm (B_2)	58.45	2.71	6.69	78.68	49.39	48.24	53.40	0.93	12.09	228.00
20 × 7.5 cm (B_3)	57.50	2.80	6.44	80.95	47.16	44.82	56.90	0.86	11.94	231.23
20 × 10 cm (B_4)	53.62	2.62	6.81	82.75	48.33	50.24	52.70	1.02	12.38	209.46
$CD_{(0.05)}$ B	1.80	0.21 NS	0.46 NS	4.21	4.09	6.02 NS	11.67	0.36	0.89 NS	15.65
Interaction (A × B)										
$A_1 \times B_1$	58.88	2.38	6.00	83.82	45.75	49.71	35.50	1.63	12.26	186.66
$A_1 \times B_2$	57.12	2.15	6.00	83.80	47.12	44.96	41.90	1.07	12.32	221.01
$A_1 \times B_3$	57.72	2.30	6.14	86.56	47.30	47.35	57.10	0.96	12.16	226.74
$A_1 \times B_4$	52.08	2.28	6.58	83.52	45.48	57.32	56.70	0.99	12.30	208.92
$A_2 \times B_1$	60.38	3.07	7.46	68.58	44.57	48.16	47.90	1.17	11.22	248.21
$A_2 \times B_2$	59.78	3.27	7.37	73.56	51.66	51.51	64.90	0.79	11.86	234.99
$A_2 \times B_3$	57.28	3.30	6.74	75.34	47.01	42.29	56.70	0.77	11.72	235.71
$A_2 \times B_4$	55.16	2.96	7.04	81.98	51.18	49.15	48.70	1.04	12.46	209.99
$CD_{(0.05)}$ A × B	2.54	0.29	0.65	5.95	6.06	8.51	16.51	0.51	1.26 NS	35.42
CV (%)	3.43	8.33	7.52	5.77	9.85	13.68	24.90	13.35	8.06	17.57

by Alam *et al.* (2) in common garlic (*Allium sativum*). Highest bulb yield in planting distance 20 × 7.5 cm was also accompanied with maximum bulb volume (56.90 cm^3). Highest specific gravity of bulbs and leaf length was registered in 15 × 7.5 cm spacing (1.40 g/cm^3 and 59.63 cm, respectively). The widest planting distance, *i.e.*, 20 × 10 cm was found to be promising for shoot girth (6.81 cm), plant height (82.75 cm), bulb weight (50.24 g) and number of cloves per bulb (12.38). Higher bulb weight in wider planting distance accompanied with lower bulb yield indicated that bulb weight was principal yield attributing factor rather than the number of plants accommodated per unit area. Therefore, more number of even small bulbs in close planting geometry was more important for getting higher yield rather than less number of bigger bulbs under wider spacing. Similar trend was also realized by Alam *et al.* (3) in garlic.

The interaction effect of planting distance with seed cloves was also found significant for all the traits except number of cloves per bulb. Highest bulb yield was recorded in $A_2 \times B_1$ (248.21 q/ha) followed by $A_2 \times B_3$ (235.71 q/ha), $A_2 \times B_2$ (234.99 q/ha), $A_1 \times B_3$ (226.74 q/ha) and $A_1 \times B_2$ (221.01 q/ha) with *at par* values. It indicated that bigger sized commercial seed cloves (A_2) when planted at closer planting geometry, *i.e.* 15 × 7.5 cm (B_1) and 15 × 10 cm (B_2) or 20 × 7.5 cm (B_3) could be expected to give higher bulb yield. However, the potentiality of miniature seed cloves (A_1) could not be ignored as it has also shown statistically *at par* performance in relation to bulb yield at these planting distances. Maximum values of bulb diameter and volume was recorded in $A_2 \times B_2$ (51.66 mm and 64.90 cm^3, respectively), whereas $A_1 \times B_4$ registered maximum bulb weight (57.32 g). The treatment combination $A_2 \times B_1$ was promising for leaf length (60.38 cm) and shoot girth (7.46 cm). The bulbs obtained from the treatment combinations $A_1 \times B_1$ had highest specific gravity (1.63 g/cm^3) followed by $A_2 \times B_1$ (1.17 g/cm^3). It was evident that the bulbs obtained from closer planting distance had higher specific gravity (compactness) irrespective of miniature or commercial cloves used as seed material.

The overall results of the experiment as discussed above indicated that miniature seed cloves and

big sized commercial seed cloves had significant influence on bulb yield and vegetative growth of great headed garlic genotyped IC 0598236. However, the bulbs produced from miniature seed cloves were more compact and thus likely to have more storability as these had higher specific gravity value. Similarly, planting geometry including medium distance (20 × 7.5 cm and 15 × 10 cm) was found to increase the bulb yield by 4.86-6.35% as compared to close planting distance of 15 × 7.5 cm and 8.85-10.39% as compared to wider planting distance of 20 × 10 cm. The bulbs produced from close planting geometry of 15 × 7.5 cm had highest specific gravity. The combination of commercial seed cloves and closest planting distance (15 × 7.5 cm) was found to have highest bulb yield. Therefore, planting of commercial seed cloves at 15 × 7.5 cm is recommended for cultivation of great headed garlic genotype IC 0598236 in temperate hill conditions of Uttarakhand.

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