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SHORT COMMUNICATION

IC0598236: A Potential Genotype of Great Headed Garlic (*Allium ampeloprasum* var. *ampeloprasum* L.)

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The experiments on characterization and evaluation of collected germplasm of garlic were conducted at Vegetable Research Block of Uttarakhand University of Horticulture and Forestry, Ranichauri Campus, Tehri-Garhwal, during 2012-13 and 2013-14. A few plants exhibiting long, dark green, broader and leathery leaves, pink umbels with micro-cloves (bulbils), large bulbs and cloves were selected and multiplied clonally to generate population of uniform plants. The germplasm submitted to National Bureau of Plant Genetic Resources, New Delhi, was given IC0598236. Regarding morpho-agronomic performance, reactions to biotic and abiotic stresses, bulb yield and related traits indicated that IC0598236 was botanically *Allium ampeloprasum* var. *ampeloprasum* L. It exhibited about 38.9% higher mean bulb yield (239.8 q/ha) than *Agrifound Parvati* (174.2 q/ha), a commercial variety of common garlic (*A. sativum* L.), due to larger bulb size (68.4 g mean bulb weight) and cloves (62.6 g, 10 clove weight). The genotype IC0598236 was comparable with commercial cultivar *Agrifound Parvati* of *A. sativum* in relation to TSS and dry matter in cloves. Under field conditions, it can withstand moisture and biotic stresses very well. On the basis of these many beneficial characteristics, IC0598236 (*Allium ampeloprasum* var. *ampeloprasum*) could be recommended as a potential commercial crop of Uttarakhand hills.

Key Words: *Allium ampeloprasum,* Commercialization potential, Elephant garlic, Great Headed garlic, Levant garlic

The genus *Allium* represents a large diversity with respect to morphology of bulbs, nature of bulbing and appearance of foliage. Almost all the species of alliums are found in Mediterranean region, the adjoining areas of Western Asia and South-eastern Europe (USDA GRIN, 2011). In Indian sub-continents, two species of *Allium* viz., *A. cepa* L. and *A. sativum* have been under cultivation since ancient times. A few decades back some other species *viz., A. fistulosum* L.*, A. porrum* L.*, A. schenoprasum* L. etc. have been introduced in this country. Occurrence of *A. ampeloprasum* commonly called great headed garlic, elephant garlic or Levant garlic in India or abroad is confined to restricted areas of Himalayas. This species is reported to be under cultivation in South-western England and France (Bohanec *et al*., 2005). Some *Allium* species, producing umbels consisting of numerous bulbils identical to small cloves, have been identified as *A. ampeloprasum* but all the varieties of *A. ampeloprasum* essentially do not have bulbils (Block, 2010). However, some taxonomists identified such species bearing aerial bulbils as *Allium* species (Bohanec *et al*., 2005; Hirscheggar *et al.,* 2006). Block (2010) identified *A. tricoccum* and characterized it as broad leaved, monocloved wild leek, the progenitor of three cultivated types *viz*., leek or garden leek (*Allium porrum*), elephant or great headed garlic (*A. ampeloprasum* var. *ampeloprasum*) and kurrat or middle-eastern leek (*A. kurrat*). The controversial taxonomic position of different phenotypes of alliums many times creates confusion in identification of certain form of bulb-bulbil- and clove-bearing *Allium* species. Therefore, determining taxonomic position of all the phenotypes in alliums is indispensable for further crop improvement programmes.

To generate variability for crop improvement programme in garlic at Uttarakhand University of Horticulture and Forestry, Ranichauri Campus, Tehri-Garhwal, Uttarakhand, germplasm collection was made from different villages of Tehri district, during 2012. A few plants of *A. ampeloprasum* were identified in the population of collected lines of garlic. This species has been under cultivation in farmers' field since very

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long as an admixture with *A. sativum*. The plants exhibiting identical growth habits bearing long, dark green, broad and leathery leaves, pink umbels with micro-cloves (bulbils) and big size of underground bulbs and cloves, were selected and multiplied clonally to generate required size of population of uniform plants at Vegetable Research Block of the University. The germplasm was sent to ICAR-National Bureau of Plant Genetic Resources, New Delhi to be assigned IC number. The genetic material was further evaluated for different morpho-agronomic traits in replicated trials along with nationally- and locally- grown checks *viz.*, *Agrifound Parvati* and *Ghansali Local*, a popular local variety of common garlic (*A. sativum*) during *Rabi* 2012-13 and 2013-14. The crop was raised by planting cloves at 15 × 10 cm spacing using 5.0 q/ha seed rate in garlic lines and 8.0 q/ha in great headed garlic during the month of October. The standard package of practices of garlic was followed to raise the experimental crop. The manure and fertilizers were applied at 15 t/ha FYM and 100:80:60 kg/ha NPK and the crop was irrigated by sprinkling water as and when required. Mulching with dried grasses was also done to conserve soil moisture and keep the field free from weeds. The bulbs were harvested during first fortnight of May.

Plants are foliaceous with dark green, flattened and leathery leaves about 46.0 cm long and 2.8 cm wide. Plants bear 10-12 leaves in the whole life span (Fig. 1). The central growing portion of shoot develops into a flowering stalk bearing terminal umbel at crop maturity during spring-summer. The umbels consist of tiny anthers, arising from the base of ovaries and developing in to micro-cloves (bulbils in the case of common garlic), by storage of food material (Fig. 2). The reproductive system in this species is non-functional. The micro-cloves have meristematic tissues differentiating into roots and shoots. Each umbel bears about 150-175 micro-cloves and one gram of it has 28-32 micro-cloves. The viability of micro-cloves varies from 10-12 months under ideal storage conditions. The newly identified line IC0598236 bears pink umbels at plant maturity and has large bulbs and cloves (Figs 2 & 4). The umbels consist of small cloves or bulbils which can generate new plantlets (Fig. 3). On the basis of detailed phenotypic resemblance described by Bohanec *et al*. (2005) and Hirscheggar *et al.* (2006), this collection was identified as belonging to genus *Allium* and species *ampeloprasum* of family Alliaceae. According to Brewster (1994), *A. ampeloprasum* does not normally produce bulbs, although the variety *ampeloprasum*

Fig.1. Crop in the field

Fig. 2. Appearance of umbels during crop maturity

Fig. 3. Bulbs and umbels with micro-cloves

Fig. 4. Arrangement of cloves in the bulb

(elephant garlic) has been found to produce a head of cloves like garlic (*A. sativum*) but with two sizes of cloves, bigger cloves like garlic, surrounded by smaller ones, on the outside. Thus, on the basis of description given by Brewster (1994, 2008), it was concluded that IC0598236 was botanically related to *A. ampeloprasum* var. *ampeloprasum,* commonly known as elephant garlic or great headed garlic.

The great headed garlic line IC0598236 is tolerant to foliar diseases like purple blotch and downy mildew. However, incidence of root rot is realized during prolonged, high soil moisture conditions (Table 2). There is no conspicuous infestation of common pests in alliums of temperate hills. This species is tolerant to frost as the area of its occurrence is fraught with severe and prolonged frost. For optimum performance this requires light rains or sprinkling at 8-10 days intervals.

As presented in Table 1, the performance of IC0598236, was compared with two genotypes of *A. sativum* viz., *Agrifound Parvati* and a locally grown landrace *Ghansali Local* for two years, during 2012-13 and 2013-14. Results indicated that IC0598236 had significantly higher bulb yield than both the genotypes of *A. sativum* during both the years (248.8 q/ha in first year and 230.7 q/ha in second year) which were higher by 47.3% and 28.5%, respectively as compared to *Agrifound Parvati* with bulb yield of 168.9 q/ha during first year and 179.5 q/ha during second year. This genotype was again promising for bulb weight (65.5 g and 71.2 g) and 10 clove weight (61.3 g and 63.8 g) during both the years. Higher bulb yield in IC 0598236 was associated with heavier bulbs and bolder cloves. Among the *A. sativum* genotypes, local cultivar exhibited higher bulb weight (35.8 g and 33.6 g) and 10 clove weight (35.4 g and 36.5 g) during both the years as compared to popular high yielding variety *Agrifound Parvati* (30.2 g and 37.8 g and 29.8 g and 31.4 g, respectively). The heavier bulbs, larger cloves and, broader, dark green and more leathery leaves in genotype IC0598236, was probably because of its tetraploid karyotype resembling different forms of *A. ampeloprasum* (Figliuolo and DiStefano, 2007). Variable ploidy level and chromosome number in *A. ampeloprasum* (16-56) has also been mentioned by Mathew (1996). As far as TSS and dry matter content in cloves was concerned, the landrace *Ghansali Local* again registered higher values for these quality traits during both the years viz., 43.5% & 44.0% TSS and 56.4% & 56.05% dry matter content during first year and second year, respectively. The IC0598236 and *Agrifound*

Table 1. Comparative performance of great headed garlic (*Allium ampeloprasum* L. var. *ampeloprasum*) and cultivars of common garlic (*Allium sativum* L.)

Genotypes	Days to maturity		Bulb weight (g)		10 Clove weight (g)		Total soluble solids in cloves (%)		Dry matter content in bulb (%)		Marketable bulb yield (q/ha)	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
A.ampeloprasum (IC0598236)	180	180	65.5	71.2	61.3	63.8	41.5	41.0	46.5	48.2	248.8	230.7
A. sativum L. (*Agrifound Parvati)*	170	175	30.2	27.8	29.8	31.4	39.0	38.5	45.6	46.7	168.9	179.5
A. sativum L. (*Ghansali Local*)	185	180	35.8	33.6	35.4	36.5	43.5	44.0	56.4	56.05	108.7	114.6
SE (m)	1.8	2.2	0.93	1.2	1.85	1.7	1.2	1.3	0.9	0.76	6.4	9.2
CD (0.05)	3.9	4.7	2.0	2.6	3.96	3.7	2.6	2.8	1.9	1.6	13.7	19.73
CV (%)	5.0	7.3	11.6	13.4	8.6	10.8	4.5	5.6	7.2	5.8	13.5	10.6

Table 2. Relative disease reactions of great headed garlic (*Allium ampeloprasum* L. var. *ampeloprasum*) and cultivars of common garlic (*Allium sativum* L.)

Genotypes	Incidence of Purple blotch (%)		Incidence of Downy mildew (%)		Root rot (%)	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
A.ampeloprasum (IC0598236)	2.5	2.0	3.8	2.6	15.8	21.6
A. sativum L. (*Agrifound Parvati)*	23.9	19.5	12.4	11.9	8.7	13.5
A. sativum L. (*Ghansali Local*)	25.6	26.5	9.7	10.3	5.6	8.3
SE (m)	2.7	3.2	1.7	2.1	1.2	1.6
CD (0.05)	5.86	6.94	3.66	4.52	2.58	3.44
CV (%)	16.8	13.5	9.2	8.6	12.3	13.2

Parvati exhibited non-significant difference for TSS and dry matter content during both the years although higher values for these traits were observed in the former.

It gave about 38.9% higher bulb yield than *Agrifound Parvati*, a commercial variety of common garlic (*A. sativum*) due to larger bulb size and cloves. The genotype IC0598236 was comparable to the commercial cultivar *Agrifound Parvati* with respect to TSS and dry matter content of cloves. Under field conditions, it can withstand moisture and biotic stresses very well. On the basis of morpho-agronomic performance, reactions to biotic and abiotic stresses and, bulb yield and related traits which are beneficial characteristics, IC0598236 (*A. ampeloprasum* var. *ampeloprasum*) holds the potential as a commercial crop in Uttarakhand hills.

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