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A note on frost induced garlic (*Allium sativum* L. var. *sagitatum* Kuz.) mutant with larger aerial bulbils

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Abstract

A natural frost induced mutant of garlic (*Allium sativum* L. var. *sagitatum* Kuz. cv. Agri Found Parvati), producing normal clove-sized aerial bulbils, was isolated from extreme cold-arid trans-Himalayan deserts of Ladakh (9,000–18,500 ft above MSL), India. The yield after a season's growth from mutated bulbils (42.3 g) was slightly less than that realized from second season's growth in conventional bulbils (46.7 g) and greater than that from normal cloves (39.3 g). This mutant, ensuring commercial garlic production from aerial bulbils within a single season itself, was stable over two successive generations.

Keywords: aerial bulbil, *Allium sativum*, garlic, mutation, propagation.

Ladakh (9,000–18,500 ft above MSL) in the trans-Himalayan zone of India is agriculturally unique with its extreme cold-arid desert conditions. Garlic (*Allium sativum* L.) was an unknown crop to this region until introduced by Defence Research and Development Organization during 2002 (DRDO 2005). The success of this crop coupled with cold tolerance (surviving even –20°C in winter), huge demand from civilian and army sectors and high prices (about Rs. 180 kg^{-1} in January 2006) have led to mass cultivation of the crop in the region, opening a new crisis on planting material availability.

Unlike progenitors, the cultivated garlic fails to produce sexual seeds naturally (Etoh & Nakamura 1988). Though cultivated Asiatic garlic (*A. sativum* L. var. *sagitatum* Kuz.) succeed in bolting upon satisfying specified photoperiodic and morphologic requisites (Mathew *et al*. 2005a), sterility of fertile flowers is induced due to partitioning of synthates by simultaneously developing sinks namely cloves, aerial bulbils and floral parts, leading to inadequate nutrients for the development of pollen grains and their subsequent degeneration (Koul & Gohil 1970; Pooler & Simon 1994; Simon & Jenderek 2003; Etoh & Simon 2002). Management of photoperiod, temperature of storage, growth and development affect bolting and florogenesis (Kamenetsky *et al*. 2004).

Under long photoperiodic and extreme low temperature conditions of Ladakh, flowering and aerial bulbil development (Fig. 1a) is a general phenomenon in garlic (Mathew *et al*.

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Fig. 1. Frost induced garlic (*Allium sativum* L. var. *sagitatum* Kuz.) (cv. Agri Found Parvati) mutant a. **F**lower head bearing normal aerial bulbils b. Mutant with normal clove - sized aerial bulbils c. Comparative sizes of planting materials (1) normal aerial bulbil (2) plant from first season culture of aerial bulbil, to be used for commercial crop (3) aerial bulbil from mutant (4) normal garlic clove used for raising commercial crop

2005b). Experiments on diverting the nutrients from the developing bulbils, including their manual removal at early bolting and at initiation of flower-bulbil differentiation, provision of reduced photoperiod for flower heads bearing complete flowers, assisted pollination and synchronization of bolting with medium winter were fruitful in sexual seed development (unpublished data).

Though acceptable for the initial immediate requisite of multiplication for mass adoption, propagation through bulbils is handicapped with the double season requisite in this procedure (Singh *et al*. 2003). Within one season's growth, bulbils (Fig. 1 a)weighing an average of 1 g will develop into single cloved bulbs of around 15.1 g each and has to grow to complete bulbs in the second season. This condition necessitates an alternate propagation methodology combining mass multiplication, true to type nature and attaining of marketable yield within a single season.

A spontaneous mutant of garlic (cv. Agri Found Parvati) producing bigger (mean bulbil weight of 8.31 g and 1.62 cm bulbil diameter) aerial bulbils (Fig. 1 b) was identified under open field conditions of Leh in Ladakh sector (longitude 77.40 E, latitude

34.10 N, altitude 11,550 feet above MSL). The parent crop was planted in the first week of August 2004 and was *in situ* over-wintered with cent per cent survival. The mutant produced up to 8 aerial bulbils on an inflorescence, doubling the propagation potential over conventional crop. The mutant was at par with the bulb obtained from a conventional aerial bulbil after a season's growth as well as the normal clove (Fig. 1 c). The yield after a season's growth from mutated bulbils (42.3 g) was slightly less than that realized from second season's growth in conventional bulbils (46.7 g) owing to the extra time required for root initiation and greater than that from normal cloves (39.3 g).

This kind of spontaneous mutation under extreme cold conditions in garlic is well demonstrated (Chang & Park 1980). The mutation was genetic and stable since both M_1 and M_2 generations developed normal marketable cloves and large bulbils within a season. Thus spontaneous mutation could be adopted as an alternate breeding strategy in garlic by endorsing the mutative potential of frost in this asexually propagated crop.

References

Chang J I & Park Y B 1980 Studies on the improvement of garlic cultivation in Cheju. 2. Effect of cold treatment of garlic cloves and the transplanted seedlings on yield. J. Korean Soc. Hort. Sci. 21: 1.

Etoh T & Nakamura N 1988 Comparison of the peroxidase isozyme between fertile and sterile clones of garlic. In: Proc. 4th EUCARPIA *Allium* Symposium, 6–9 September 1988, Wellesbourne, UK (pp. 115–119).

Etoh T & Simon P W 2002 Diversity, fertility and seed production of garlic. In: Rabinowitch H D & Currah L (Eds.) Allium Crop Science: Recent Advances (pp. 101–117). CAB International, Wallingford.

DRDO (Defence Research and Development Organization) 2005 Annual Report 2005, Field Research Laboratory, Defence Research and Development Organization, C/o 56 APO, India.

Kamenetsky R, Shafir I L, Zemah H, Barziley A & Rabinowitch H D 2004 Environmental control of garlic growth and florogenesis. J. Amer. Soc. Hort. Sci. 129: 144–151.

Koul A K & Gohil R N 1970 Causes averting sexual reproduction in *Allium sativum* Linn. Cytologia 35: 197–202.

Mathew D, Ahmed Z & Singh N 2005a Formulation of flowering index, morphological relationships and yield prediction systems in true garlic aerial seed bulbil production. HortScience 40: 2036–2039.

Mathew D, Kumar N & Ahmed Z 2005b Flowering index and morpho-relationships in garlic aerial seed bulbil production. In: Abstracts, First National Horticultural Congress, 6–9 November 2005, New Delhi (p. 135). Horticultural Society of India, New Delhi.

Pooler M R & Simon P W 1994 True seed production in garlic. Sex. Plant Reprod. 7: 282–286.

Simon P W & Jenderek M M 2003 Flowering, seed production and the genesis of garlic breeding. Plant Breed. Rev. 23: 211–244.

Singh N, Raut B & Kumar N 2003 Cultural Tips for Vegetable Production in Ladakh. Field Research Laboratory, Defence Research and Development Organization, C/o 56 APO, India.