



Research Article

GENETIC ENHANCEMENT OF FLOWERING IN GARLIC (*Allium sativum* L.)

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Abstract- Garlic is being generally propagated asexually by cloves, clones does not produce flowering bolt are known to be soft-necked garlic types, however rarely hard-neck garlic types does produce flowering bolts. Bolting lead to the emergence of solid scape produces flowers in umbellate inflorescence, are amid with bulbils. The small undivided bulbs referred as top-sets or air-bulbs are also used for propagation of garlic clones. However, the flowers rose in an umbel are did not set the seeds due to the under developed gametophytes could cause male and female sterility. Possibly to mitigate these impediments, research has been trialed to genetic improvement garlic by transformation of transition from asexual reproduction to sexual reproduction by the induction of flowering in garlic intern may further advised to genetic variability in garlic for further genetic improvement expected to cause for exploitation of heterosis.

Key Words- Garlic flower, Scape

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Introduction

Garlic (*Allium sativum* L.) is diploid ($2n=16$) plant most likely to be sterile, it might be caused due to the occurrence of abnormal meiosis during gametogenesis and nutritional competition between the top-sets amid with flowers might be a limitation in sexual seed production in garlic. Therefore, garlic thus propagated by cloves, top-sets or bulbils as asexually [9]. The asexual propagation limits the creation of genetic variation and variability is most needed in garlic genetic improvement, which is possibly achieved by critical selection, spontaneous, induced mutations and somaclonal variations of locally available clones. The limited variability restricted the genetic improvement of garlic traits namely bulb yield, quality and stress resistant. However, the fertile clones are found in Central Asia [14], it is a diversity hot spot of garlic where reported the primitive fertile clones which does produce true seeds of garlic (TSG), particularly the Tien Shan Mountains region [1, 5, 8] and the area is likely to be the center of origin and diversified center of garlic. Probably the species have evolved from fertility to sterility by greater affinity of human selection towards asexual propagules since they used in culinary as and when needed and propagules for multiplication. Garlic is cultivated across the world from temperate to sub-tropical climate; India is the second largest producer of garlic after China. However, productivity of garlic in India is very low (5 t/ha –of which $\approx 20\%$ bulb yield is required to raise subsequent crop) compared to china (25 t/ha). In spite of its tremendous medicinal importance, area under garlic cultivation has not much extended by the Indian farmers may be due to the low productivity, insufficient and quality planting material *i.e.* cloves (true garlic seeds (TGS)) and lack of true seeds of garlic [9]. In this context, there is a need to drive technologies to break barriers of low bulb yield and vegetative propagation, through invasion of innovative breeding and production methods to boost the garlic productivity and sexual propagation.

In view of broadening the genetic variability and to enhance the genetic resources of hard necked flowering garlic. Exploration and collection of hard necked, bolting habituated, fertile garlic clones diversified northern Karnataka region had performed. Identified locally available genotypes possess economically useful traits like bolting habit in the local variety Gadag-Local. It is outstanding genotype produces underground bulbs containing cloves and top-sets or bulbils containing flowers in the inflorescence when grow in open field [Fig-1]. Breeding strategies and techniques are adapted to avoid hurdles to induce flowering in garlic, transition breeding to make stable performance of long-day bolting cultivars to induce bolting under short-day condition.



Fig-1 A). Hard neck type garlic producing flower stack with scape containing bulbils: B). Garlic flowers in an aggregated umbel

Materials and Methods

Results and Discussion

An indigenous potential local cultivar Gadag-Local produces purple stripe pigmented bulb containing cloves, is an early bulb forming ecotype produce bolts inflorescence is an umbel, and it does produce flowers which are arising from a common meristem along with top-sets, or bulbils in tropical plains under short-day condition, may be due to stabilized vegetative growth lead to the further transition of the shoot apical meristem to reproductive meristem, through regulation of FT genes [13]. The short-day garlic cultivar Shani produces a short flower stem, but instead of an inflorescence it develops a small top-set [6], further improvement of these genetically important variability traits could lead to induction of flowers and possibly fertility restoration may attained in further and subsequent generations with the greater affinity of critical selection from vegetative reproduction to the sexual reproduction. However, restoration of flowering ability in garlic is greatly influenced by environmental manipulations [7], these supporting citations could reveal by attempting best agronomic practices in suitable environment bolting habituated clones are presumed to flower and restore the fertility. However garlic preponderantly has low flowering ability [4, 6] and is considered to be sterile genotype. The sterility of the garlic flowering is mainly attributed by the deletions of chromosomal, variable differences in the length of homologous chromosome, loss of genes during gametogenesis, hypertrophy of the tapetal tissue of the anthers at the post-meiotic stage and degeneration of microspore before and after tetrad stage and competition for nutrition between the top-sets and flowers for their development, in which top set suppress the expression of flower phenotype [1, 10-12]. However, true seeds of garlic (TSG) are reported in few fertile clones of garlic, further true seeds were used in garlic improvement [3]

Conclusion

Garlic flower induction and fertility restoration for production of True Seeds of Garlic (TSG) is the prime importance at present era of garlic breeding by classical breeding methods like introduction, transition breeding and selection or by advanced bio-technology through engineers of flowering (FT gene) genes and their over expression, down regulation or knockdown of genes which are suppressing the flowering expression with use of RNA-interference and other genome editing technologies would be beneficial to speed up the breeding process. Because, garlic seed production and multiplication will be a more valuable, economical and it is suitable method to eliminate virus and nematodes than the labor-intensive meristem culture. Ultimately, TSG production possibly reduces plant material cost and quantity requirement. In addition, true seeds of garlic production by the establishment of sexual reproduction would provide a means for evaluating the extent of variation in the garlic gene pool.

Application of Research

The research is way to induce sexual reproduction in garlic, it interns reduce the seed cost of production and ensure quality seed to better yields, which presently reproducing by asexually by cloves.

Research Category: Genetics and plant breeding

Abbreviation

TSG : True Seeds of Garlic
FT : Flower transition gene
RNA : Ribose Nucleic Acid
TGS : true garlic seeds

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References

- [1] Etoh T. (1985) *J. Japan. Soc. Hort. Sci.*, 55(3), 312–319.
- [2] Etoh T. and Hong C. (2001) *Acta Hort.*, 555, 209–212.
- [3] Etoh T. (1997) *Acta Hort.*, 433, 247–255.
- [4] Etoh T., Simon P.W., Rabinowitch H.D. and Currah L. (2002) Diversity, fertility and seed production of garlic. Wallingford, United Kingdom. pp 101–117.
- [5] Hong C. J. and Etoh T. (1996) *Breeding Science*, 46,349–353.
- [6] Kamenetsky R. and Rabinowitch H.D. (2001) *Sex Plant Reprod.*, 13, 235–241.
- [7] Kamenetsky R., Shafir I., Zemah H., Barzilay A., Rabinowitch H.D. (2004) *J. Am. Soc. Hort. Sci.*, 129, 144–151.
- [8] Kotlinska T., Havranek P., Navratil M., Gerasimova L., Pimakov A. and Neikov S. (1991) *Plant Genetic Resources Newsletter*, 83/84, 31–32.
- [9] Manjunathagowda D.C., Gopal J. Archana R. and Asiya K.R. (2017) *Int. J. Curr. Microbiol. App. Sci.*, 6(6), 2446-2456.
- [10] Novak F. J. (1972) *Experientia*, 28, 363–364.
- [11] Novak F.J. and Rabinowitch H. . (1990) *Allium Tissue Culture*. Brewster, J. L. (Ed). Onions and Allied Crops. pp 233–250. CRC Press, USA.
- [12] Pooler M. R. and Simon P. W. (1994) *Sexual Plant Reproduction*, 7, 282–286.
- [13] Shalom S.R., Gillett D., Zemach H., Kimhi S., Forer I., Zutahy Y., Tam Y., Teper-Bamnolker P., Kamenetsky R. and Eshel D. (2015) *Planta*.
- [14] Vavilov N.I. (1926) *Bulletin of Applied Botany and Plant Breeding*, 16, 1–248.