

Short Communication

VRRAD-201 (INGR20032): First Ogura-CMS line of radish with sinuate leaf for hybrid development

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Radish (*Raphanus sativus* L., $2n=2x=18$) belonging to Brassicaceae family is a most reliable year-round vegetable crop grown worldwide for fleshy edible roots and soft leaves. Genus *Raphanus* is a Greek word which means ‘quickly appearing’ and representing to the quick germination and fast-growing nature of the plants. Radish is an ancient crop, most probably native to the eastern Mediterranean and the Middle East where maximum diversity prevails. However, central China, central Asia and Hindustani center of origin appear to be secondary centers where differing forms were evolved during period of domestication. The ancient varieties were long and tapered rather than cylindrical, apically bulbous, elliptic or spherical. There are three independent domestication events for black Spanish radish, European cultivated forms and Asian cultivated radish. It has various category, broadly varying in leaf shape or leaf division incision (lyrate, sinuate, entire), root colour (white, red, purple), root shape (triangular, cylindrical, apically bulbous, elliptic), and vernalization requirement (temperate, tropical) [Singh 2021]. Coloured radishes make salad decorative and nutritious, and good source of polyphenols and anti-oxidative properties (Singh et al. 2017). Globally, the uses of F_1 hybrids of many vegetables have increased manifold during last few decades, including India. In India, it is cultivated in one or the other parts of country almost throughout the year because of geographical distribution, heat/humid tolerant productive cultivars, economic importance and consumers’ demand (Singh et al. 2017). Heterosis (hybrid vigour) is of direct interest for development and commercialization of F_1 hybrids in various vegetable crops which is being facilitated by cytoplasmic male sterility (CMS) and self-incompatibility (SI) in radish. But, SI system in most of the radish genotypes is very

weak and unstable and there is always chance to get undesirable number of sibs in hybrid seeds; hence CMS system is mostly preferred for hybrid development. The radish hybrids should possess few common traits like wide adaptability, high uniformity, ability to tolerate biotic/abiotic stresses, superior quality of produce, attractive appearance and high productivity.

In radish, heterosis breeding is based on the principle of selecting parents, developing homozygous inbreds/DHs and SI/CMS lines, testing combining ability, evaluating cross-combinations, and commercial production of F_1 hybrid seeds. CMS was first identified in a cultivar of Japanese radish by Ogura (1968) popularly known as Ogura-CMS, and thereafter it has been transferred into various backgrounds of different *Brassica* vegetable. Although it is the most important salad crop in India because of availability of roots round the year, yet it is unfortunate that none of the radish CMS lines by Public Sector Institutes is available on public domain in our country because of less priority for research in this crop. Keeping in view of the importance and advantage of CMS lines especially in easy maintenance of female parent, harnessing heterotic vigour for economic traits, and cheaper & quality seed production of F_1 hybrids; ICAR-IIVR, Varanasi, UP has developed many CMS lines by backcross method, namely VRRAD-11, VRRAD-12, VRRAD-41, VRRAD-198 and VRRAD-201. The Ogura-CMS line ‘VRRAD-201 or A Line’ (IC0625064), First Ogura-CMS line from Public Sector in India, was developed by crossing CMS plants from open population with an elite line ‘VRRAD-202 or B Line or Maintainer Line’ (IC0625065) which is having better combining ability and higher heterosis for various economic traits during winter and summer seasons (Singh et al. 2018, Singh and Singh 2020). Female parent VRRAD-201 showed better heterotic effects for various traits of economic importance like root length, root weight, leaf weight, gross plant weight, harvest index and marketable yield during winter and summer season (Singh and Singh

2020). Additionally, significant heterosis for yield, longer roots, earliness, vigour consistency and uniformity have also been reported by many researchers (Kutty and Sirohi 2003, Kochetov and Sinyavina 2019).

The line 'VRRAD-201' possesses desirable leaf shape i.e. sinuate type of leaf morphology (leaf division incision), develops root during winter, spring and summer seasons, having white and triangular root, bears whitish-purple flower, and ready to seed harvest in about 4 months after transplanting of seedlings. The quantitative traits of economic importance of CMS line 'VRRAD-201' during winter season of 2016-2019 were observed such as gross plant weight 258.5-275.0 g, root weight 181.2-190.0 g, root length 24.8-26.0 cm, shoot length 35.9-38.4 cm, root diameter 3.3-3.6 cm, number of leaf 9.9-10.7, 40.2-52.4 days to first root harvest, marketable yield 53.9-60.2 t/ha, 34.2-38.1 days to 50% flowering, 381-410 number of pods/plant, 4.2-4.5 number of seeds/pod and 1000 seed weight of 12.8-13.5 g. Moreover, economic parameters of its maintainer 'VRRAD-202' during 2016-19 were realized as 252.1-270.0 g gross plant weight, 171.3-182.5 g root weight, 22.5-24.3 cm root length, 35.1-37.1 cm shoot length, 3.2-3.7 cm root diameter, 10.5-11.1 number of leaf, 41.8-52.9 days to first root harvest, 50.6-59.1 t/ha marketable yield, 30.1-33.5 days to 50% flowering, 360-382 pods/plant, 4.0-4.5 number of seed/pod, and 11.8-12.2 g of 1000 seed weight. Furthermore, the commercial F_1 hybrid seed of radish can be produced very economically by transplanting seedlings of Female:Male parents in the ratio of 3-4:2 and managing adequate bee-hives for proper pollination. The CMS line 'VRRAD-201' has been registered as unique germplasm (INGR20032, IC 0625064) by ICAR-NBPGR, New Delhi.

In conclusion, newly developed robust CMS line 'VRRAD-201' would be very effective in harnessing heterotic potential, developing F_1 hybrids for winter and summer season cultivation, and cost-effective commercial hybrid seed production in radish.

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