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Pysca-1 : A Mutant Line for Apetalous Flower in Yellow Sarson (Brassica rapa Var. Yellow Sarson)

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ABSTRACT

Augmenting the seed yield by changing the plant architecture using primary morphological component of seed yield like seeds size, pod number, number of seeds, primary branches has been advocated since long back. Other morphological traits such as erect leaf and pod posture, splitting leaf shape, dark green leaf colour, waxed leaf surface apetalous flower and basal branches can be the new area of interest and research in crop breeding for high grain yield in rapeseed. Apetalous flower is reported in brassicas and found more effective in photosynthesis and reallocation of assimilates due to the removal of the yellow flower layer. Moreover, apetalous types may avoid some diseases, especially rapeseed stem rot (*Sclerotinia sclerotiorum*) or downy mildew (*Peronospora parastica*). One of such mutants was found in yellow sarson germplasm collected from the Uttarakhand hills. It was observed in as a natural mutant and is being maintained through selfing. Initial data suggested involvement of multiple alleles. Its detail inheritance in yellow sarson is still to be uncovered.

Key words : *Apetalous mutant, yellow sarson, Brassica rapa var. yellow sarson, germplasm.*

Globally India is the third largest edible oil producing economy of the world and *Brassica* oilseeds account for almost 5% of the gross national product and 10% of the value of the agricultural products, and thus contributes to the stability of the agricultural economy of the country. Rapeseed-mustard crops are being cultivated in 53 countries spreading over six continents across the globe. Oilseed Brassica is the second most important edible oil crop of the world annually producing more than 26 million tonnes (mt) oil from almost 37.6 million hectare (mha) cultivated area. In terms of area under oilseeds India holds premier position in the world, but the yield of most of the oilseed crops is less than the world average. In India, it is the most important oilseed crop contributing 35% production (2.58 mt) to primary sources and almost one-fourth to total domestic edible oil production of 11.0 mt, although it is second in normal acreage (6.13 mha) after soybean (11.25 mha). On the other hand, the demand for edible oils is increasing very rapidly with increasing population and has been estimated at 11.12 tonnes by 2030.

India (14.8%) is having third largest share in rapeseed-mustard production in the world, next only to China and Canada. Among annual oilseeds, rapeseed and mustard contributes about 23% acreage and over 25% production over the last five years in the India. In India major rapeseed-mustard growing states are Rajasthan, Uttar Pradesh, Madhya Pradesh, Gujarat, Haryana and Punjab. The jump in the production is largely accounted by the *Brassica* group specially *Brassica juncea* which occupies more than 80 % of total area under rapeseed-mustard (1). Among *Brassica rapa* ecotypes, yellow sarson is mainly grown in Assam, Bihar, Uttar Pradesh, Sikkim and West Bengal. It occupies an important position due to the presence of high amount of good quality oil (up to 48%), high seed yield and medium maturity (~110-115 days) as compared to Indian mustard (130-150 days). Furthermore, its yellow seed coat colour has preference over brown seed coat colour. The oil is mainly used for edible purposes and in addition to this, the yellow sarson is most preferred as leafy vegetables among the entire cultivated oilseed Brassicas in India.

The brassica scientists have shown interest in the development of apetalous varieties since long as the apetalous lines are thought to give more yields due to more penetration of light and low infestation of sclerotinia stem rot disease (2). The significant yield increment in the apetalous lines has been reviewed by (3, 4). Senescing petals provide a saprophytic food base for the germination of ascospores of the sclerotinia rot fungus and the growth of the mycelium into leaves and stems of the plant. In the absence of food source provided by the petals, as is the case with apetalous plant, the fungal ability to infect plants is greatly reduced (5). The earliest report of apetalous flower character was provided by (6). In *B. napus* first apetalous genotype was identified in the Australia (7) and this was later developed into a variety. Later on, many scientists have reported the apetalous flower in Brassicas (8 and 9).

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Fig.-1 : View of apetalous plants (a). Close view of apetalous flower (b).

Materials and Methods

Uttarakhand is rich in biodiversity. The wide differences in climate within the state create an environment for diverse agricultural crops and natural vegetation. Among the crops grown, oilseed crops have a special place in hill agriculture and a rich diversity in germplasm of *Brassica* crops occurs. But these germplasm accessions of *Brassica* crops have not been properly collected from their native areas and purified. This valuable germplasm is being conserved unnoticed as traditional and sustainable hill farming and facing the threat of genetic erosion. During sporadic explorations of Uttarakhand hills by Pantnagar scientists and material collected by them led to the isolation of some very useful and unique germplasm viz; fodder type (FS-902, FS-908, etc), saag types or leafy vegetable types (EE-1, EE-4 etc), resistant sources to Alternaria blight (PHR-1 and PHR-2) and extra short duration toria (Lohaghat local toria, 65days).

The *Brassica* germplasm exhibit wide variations in growth habit, maturity duration, yielding ability, quality characters, and resistance to diseases and insect-pests. The desired traits of such germplasm can be further exploited to breed superior varieties by using them as donors in crop breeding programmes. Exploration and Collection of *Brassica* germplasm and their relatives from Uttarakhand Himalayan region was conducted and these accessions would be purified and evaluated for morpho-agronomic characterization. A local germplasm of yellow sarson (GP-11-102) which was collected from Ghatigad village of District Bageshwar, Uttarakhand showed variability for flower colour, bearing habit and siliqua type. Germplasm is maintained as original bulk. A spontaneously occurring apetalous variant was observe in the population and isolated from above collection. The mutant was maintained by selfing through generations and evaluated for morpho-agronomic characterization.

Results and Discussion

The spontaneous mutant is resulted in an apetalous line (PYSCA-1) in which most of the flowers bear no petals (apetalous), however, one or two petals may be observed in few flowers (Fig.-1). The petals were narrow and cream colored with upright multilocular siliquae bearing and normal seed set. No adverse effect on seed set has been observed. Some times apetalous genotypes may be more effective in photosynthesis and reallocation of assimilates due to the removal of the yellow flower layer. The potential effect of the apetalous character on significantly increasing seed yield has been reviewed by (2).

Physiological assessment of apetalous character has been studied by (10). Upon making crosses with the normal flower lines, the F_1 phenotype showed normal flower type. However, in F_2 a wide range of variation was observed for presence of petals. Plants with normal flower were in maximum frequency and complete apetalous plants were in the least number. Further variation was found for number of petals (one to four) in the flower. Genetic control of apetalous character with varying number of petals appears to be complex. Detailed investigation of this trait is yet to be done.

Scan of pertinent literature shows that apetalous character is governed by recessive gene with multiple alleles and these alleles have incomplete dominance. The inheritance of the apetalous character is well documented by (7) and (11). Other reports on genetic analysis have further shown that the apetalous character was controlled by only one gene locus and petalous flower exhibited incomplete dominance over apetalous flower and that its expression was not affected by cytoplasmic factors (12). Moreover, apetalous types may avoid some diseases, especially rapeseed stem rot (*Sclerotinia sclerotiorum*) and downy mildew (*Peronospora parastica*) (13 and 14). On young petals, ascospore adhesion, germination, penetration of the host and collapse of epidermal cells were observed by scanning electron microscopy. Mycelium on petals invade leaf tissues and then infect plants. In contrast, ascospores landing directly on leaf surfaces do not germinate (15). Therefore, provide resistance against diseases. Involvement of such a unique trait will help to understand the physiological impact of the trait on seed yield and other parameters like disease resistance.

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