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Short Communication

New Sources of Variability for Restructuring *Brassica rapa*

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Abstract

Northern India, especially Himalayan tract presents rich diversity of *Brassica rapa* ecotypes (toria, yellow sarson and brown sarson) as well as leafy and condiment types of *B. juncea.* In this paper some features of unique germplasm lines collected/developed and their possible implications in restructuring of improved types as future varieties are presented. Development of two extra early maturing (<60 days) toria populations (PT-141, PT-145) out of local collections from Tehri district of Uttarakhand, and development of PYS 2008-5 with fully fertile sinks through inter-varietal crosses offers unique opportunities for genetic improvement of toria and yellow sarson, respectively.

Key words: *Brassica rapa, early toria, basal branching, unfilled sinks*

Among rapeseed-mustard, three ecotypes of *Brassica rapa* namely toria, yellow sarson and brown sarson, and *B. juncea* (mustard) are mainly grown as oilseed crop in India during winter season. These crops are grown under diverse agro-climatic conditions ranging from northern hills to down south under irrigated/rainfed, sole or mixed/ intercrop with other major rabi season crops (Chauhan *et al*., 2011). Indian mustard accounts for about 80% of the acreage under these crops. Of the brown sarson, lotni type is predominantly grown in Kashmir and Himachal Pradesh. Tora type brown sarson is almost out of cultivation.

Cultivation of yellow sarson is confined to Assam, Bihar, West Bengal, North Eastern states, Orissa, parts of Uttar Pradesh and Uttarakhand. Toria is grown as winter crop is Assam, Bihar, Orissa, and West Bengal. By virtue of its short duration and inherent high temperature tolerance during germination and seedling stages, toria is grown as catch crop in parts of Haryana, Himachal Pradesh, Madhya Pradesh, Chhattishgarh, Punjab, Uttarakhand and Uttar Pradesh. During the past over three decades acreage under toria has declined considerably chiefly due to introduction and large scale cultivation of long duration high yielding varieties of rice, in predominantly rice grown areas in northern states and growing interest in the cultivation of vegetable pea in Tarai region of Uttar Pradesh and Uttarakhand.

Genetic improvement of these crops in India has proceeded following conventional breeding approaches appropriate to their mating system. In doing so, breeding programme depended heavily on naturally occurring variability which has paid rich dividends in all these crops. The success in crop improvement, however, depends upon the nature and magnitude of variability available in the genetic resources. Northern India, especially hilly tract presents rich diversity of oilseed *Brassicas*, including leafy and condiment types (Arora *et al.*, 1991). Though substantial variability has been collected by different centre's through planned germplasm explorations, evaluated, characterized and utilized in the improvement of oilseed *Brassicas* but substantial variability in the form of land races still remains to be collected from farmers' fields and their kitchen yards in the hills of Uttarakhand. At Pantnagar, recent collections of *B. rapa* (toria, brown sarson, yellow sarson), *B. juncea* (*oleiferous* as well as leafy types) and *B. nigra* have reflected considerable variability for different traits including a few unique features like extra earliness, dwarf stature and branching patterns. Besides, unfruitfulness of terminal sinks, an inherent defect, has been corrected through inter-varietal hybridization followed by pedigree selection. This paper present some features of unique genotypes identified/developed and their possible implications in restructuring of improved types as future varieties.

Development of extra early maturing toria

Two collections of toria from Tehri district of Uttarakhand showed variability for extra earliness (<60 days) with dwarf stature. These collections after purification and selection for earliness and uniformity for height and other characters gave rise to two extra early maturing lines of toria named PT-141 and PT-145. Based on preliminary evaluation in replicated trials under irrigated condition, the main features of PT-141 and PT-145 are given in Table-1 and shown in Fig-1a and 1b. These lines are significantly early in flowering as well as maturity with dwarf plant height than the check variety PT-303.

Table 1: Main features of extra early maturing toria lines

Characters	PT-141	PT-145	PT-303	SEm±	CV (%)
Area of collection	Chamba, Distt: Tehri, Uttarakhand	Thatyur, Distt: Tehri, Uttarakhand	-	-	-
Altitude of collection site (m)	2229	1924	-	-	-
Days to flowering initiation	18	20	36	1.61	5.61
Days to maturity	56	58	95	1.70	6.55
Plant height (cm)	30.8	28.85	122	4.45	12.22
Length of main raceme	19.48	19.50	49.04	1.29	5.73
Primary branches/plot	3.80	3.50	4.93	0.30	9.53
Secondary branches/plot	5.00	8.25	6.15	0.49	10.24
Siliqua length (cm)	5.40	5.38	5.59	0.21	6.99
Seeds/siliqua	10.60	11.75	15.61	0.41	4.61
Siliquae on main raceme	18.00	19.75	26.32	0.94	7.14
Siliquae/plant	69.60	83.75	131.00	3.72	13.25
1000-seed weight (g)	2.08	2.36	2.87	0.10	7.25
Seed yield/plant (g)	2.11	2.39	4.22	0.28	12.22

In these lines flowering period is considerably reduced which increases synchrony both within and between racemes of a plant. It is known that earliness is associated with increased photoperiod insensitivity (Singh and Sharma, 1996). Earliness, or day neutrality, of varieties also increases their adaptability. With the availability of these extra early maturing lines it seems possible to design a plant type of toria which is high yielding, short stature and extra early maturing. The extra early maturity of these lines make them more suitable for their use as catch crop and regain the toria area declined in the recent past mainly due to introduction and large scale cultivation of long duration high yielding varieties of rice, in the major rice growing belt of northern India.

Further the climate changes likely to pose a bigger challenge in terms of higher temperatures, increased rainfall variability, and shifts in monsoon and growing seasons. A slight shift towards earliness in sowing time of major *Rabi* crops like wheat, due to early rise in temperature towards the end of growing season may necessitate the need for extra early genotypes of toria to fit in as catch crop in the emerging cropping situations. These genotypes also offer opportunities for re-synthesizing dwarf stature, short duration genotypes of *B. juncea,* the major *Brassica* oilseed crop grown in India.

Basal branching toria and yellow sarson

Seed yield in oilseed Brassicas is a complex trait, and artifact of several primary components of which siliquae/plant, seeds/siliqua and seed size are the most important ones. Among these traits, number of siliquae/plant appears to be more variable among genotypes which in turn depend on number of branches/plant. Further, improvement in seed yield appears to be easily achieved if more number of primary branches/plant or more number of siliquae/plant could be incorporated. Increasing main raceme length for more number of siliquae/plant will make the plant relatively taller and late in maturity. Introduction of genes for basal branching may improve the number of branches as well as number of siliquae/plant (Sinhamahapatra *et. al*, 2010).

Normally branching in toria varieties arises from main stem at wide angle with semi-spreading to spreading growth habit, which in spaced growing environments tend to spread more than in normal spacing. A toria line, PTHC-11-22, having profuse base branching trait has been isolated out of a local collection from rainfed conditions of hills in Uttarakhand. The selection was practiced for profuse basal branching types having erect growth habit and uniformity in flowering by eliminating undesirable plants before flowering and allowing random mating among the selects. The plants of this line have 9-16 primary branches about 40% of which from within 10 cm base (Fig.2a). Since in the new line primary branches grow as tall as main raceme, there appears relatively more synchrony in flowering among racemes on a plant. As such this appears a desirable trait which is lacking in existing varieties. The agronomic potential of this trait remains to be tested in different environments.

Similarly in yellow sarson also one line (PYSC 11-5) possessing basal branching has been selected out of collections from Uttarakhand hills. Plants are about 135 cm in height possess about 15 primary branches, 40% of which within 15 cm from base (Fig. 2b). Identification and use of spontaneous mutant possessing basal branching character has been reported by Sinhamahapatra *et al.*, (2010). They also reported increased number of siliquae/plant with high seed yield in yellow sarson. This trait has been found to be simply inherited in *B. juncea*, hence its incorporation in elite lines will be practically feasible. Vijaykumar *et. al.* (1997) reported that it was possible to breed for basal branching and high productivity disproving contrary opinion by some physiologists (Bhargava and Tomar, 1982; Bhargava *et al.*, 1983; Chauhan *et al.*, 1987). Based on their findings, they advocated for selection favouring basal branching types to enhance seed yield in *B. juncea*.

Development of yellow sarson lines with filled in sink apex

Rapeseed-mustard cultivars are morphologically determinate but the growth of the raceme is

Table 2:Relative variation in filled/unfilled sinks and yield related characters of PYS 2008-5 and some popular varieties of yellow sarson

Characters	PYS-2008-5	B-9	Ragini	YSH-401	Pitambari	PPS-1
Days to maturity	110	100	118	114	115	110
Plant height (cm)	120.14	103.6	108.60	114.80	123.0	109.60
	± 3.72	± 1.48	± 4.50	± 1.91	± 3.81	± 5.11
Length of main raceme (cm)	48.19	50.20	48.20	55.84	51.66	41.17
	± 2.03	± 1.47	± 2.01	± 3.29	± 1.17	± 1.12
Primary branches/plant	10.40	9.40	9.80	9.60	11.20	14.20
	± 0.57	± 1.15	± 0.65	± 0.57	± 0.65	± 0.65
Siliquae on main raceme	39.60	32.60	23.00	29.00	37.60	36.20
	± 1.35	± 2.08	± 3.12	± 1.32	± 1.04	± 1.34
Seeds/siliqua	22.70	21.20	39.80	41.60	37.40	37.40
	± 0.89	± 1.19	± 0.96	± 1.04	± 1.25	± 1.04
Length of unfilled sink (cm)	0.50	2.80	5.10	7.50	6.10	2.40
	± 0.02	± 0.17	± 0.22	± 0.13	± 0.23	± 0.21

indeterminate. On the raceme, flowers open acropetally with one or two flowers opening each day. Thus, flowering is not synchronous both within and between racemes on the same plant. Almost all available varieties/germplasm lines of yellow sarson evaluated show terminal unfruitfulness of sinks, which is obviously an inherent defect. There exist is considerable variation in the length of barren sinks in different genotypes. In general, bilocular yellow sarson genotypes exhibit less of unfruitfulness than tetralocular types. Length of unfilled sinks also varies considerably in different environments. Stress during flowering-cum-pod filling stage increases unfruitfulness.

Efforts have been made to genetically correct this defect by hybridizing genetically diverse parents, MYSL-221 of yellow sarson and Rajendra Sarson-1 of toria. MYSL 221 is a multilocular upright bearing line with large barren sinks while Rajendra Sarson-1 possesses smaller unfilled sinks. The advanced line, PYS 2008-5, derived from this cross has fully fertile terminal sinks. The salient features of this line are given in Table-2 and also shown in Fig. 3.

Existence of genetic variation and the advancement made in improving this trait indicate the possibility of genetic up-gradation of yellow sarson genotypes using this line in hybridizations.

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