Table 3. Variability parameters for agronomic characters in germplasm collection

	Mat	Ht	LL	LW	PnL	CmN	PnN	G/P	GW
Minimum	73	64	22	0.5	13.5	7	3	48.33	0.9
Maximum	120	123	56	1.1	35.5	32	26	325	3.4
Mean	88.69	96.46	34.89	0.86	22.77	14.22	8.50	125.57	2.05
STD	8.32	9.62	5.58	0.09	2.97	4.18	3.79	48.58	0.48
Skewness	1.27	-1.16	0.51	-0.12	0.07	1.49	1.58	1.45	-0.32
Kurtosis	3.38	2.39	1.68	0.92	3.05	3.61	3.92	3.03	0.28
CV%	9.38	9.97	15.98	10.79	13.06	29.41	44.66	38.69	23.26

Mat: Days to maturity; Ht: Plant Height (cm); LL: Leaf length; LW: Leaf width; PnL: Panicle length; CmN: Culm number; PnN: Panicle number; G/P: Grains/panicle; GW: 100-grain weight.

Table 4. Phenotypic correlations among agronomic characters of germplasm collection

	Mat	Ht	LL	LW
PnL	CmN	PnN	G/P	GW
Mat	-			
Ht	0.146	-		
LL	0.304**	424**	-	
LW	0.114	0.246**	0.253**	-
PnL	0.069	0.144	0.136	-0.031
-				
CmN	-0.104	-0.231	-0.235**	-0.195*
-0.056	-			
PnN	-0.241**	-0.385**	-0.386**	-0.216*
-0.100	0.696**	-		
G/P	-0.017	0.029	-0.125	0.0004
0.051	0.041	0.156	-	
GW	-0.054	0.129	0.142	-0.037
-0.008	0.121	0.042	0.0002	-

Mat: days to maturity; Ht: Plant Height (cm); LL: Leaf length; LW: Leaf width; PnL: Panicle length;
CmN: Culm number; PnN: Panicle number; G/P: Grains per panicle; GW: 100-grain weight.

(0.253**) between leaf width and plant height (0.246**). Conversely, negative and significant associations were found between culm number and leaf length (-0.235**) or leaf width (-0.195*), panicle number with leaf length (-0.386**), plant height (-0.385**), maturity (-0.241**) or leaf width (-0.216**). The study suggests that tall plants result in few panicles but higher leaf length, leaf width, late maturing cultivars manifest higher leaf length but fewer panicles. Shorter leaf length and smaller leaf width in the study is indicative of higher culm and panicle number which is a very important clue to derive productive selections for higher yields.

Identification and description of the genetic variability in germplasm collection would help in exploitation of useful traits in plant breeding and genetic improvement of rice.

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Pollination Management Perspectives of Berseem Crop – Chicory Weed Association

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Key Words: ***Trifolium alexandrinum*, Berseem, *Cichorium intybus*, Pollination**

Aspects of current agricultural production have been under serious review with a philosophical shift to sustainable agriculture. Productivity of the crop plants is greatly reduced by failure to achieve full reproductive capacity (Punjab Singh, 1988). Seed yield in sexually reproducing plants is linked to the success of pollination and fertilization processes, that in turn, depend on the adaptation of the crop to the area in which it is grown, the availability of effective pollen vectors and the molecular interaction of pollen-pistil

recognition systems (Shivanna and Sawhney 1997; Torchio 1995).

Trifolium alexandrinum L. is a widely adapted *Rabi* season legume fodder crop and *Cichorium intybus* L. (Asteraceae; Chicory) is found as dominant weed of berseem fields with an equal capacity to regenerate its vegetative shoots along with berseem after subsequent cuts. As the sowing and flowering time of chicory also coincides with that of berseem, generally, the market seed samples of berseem contain chicory seed as an adulterant. Chicory is also a major weed in other *Rabi* seasonal grain legume crops like chickpea, summer green gram and French bean reducing the yields from 35-83.3 per cent (Jain *et al.* 1997).

This peculiar berseem crop-chicory weed association necessitated an agronomic survey of selected villages from all the six tehsils of Agra District. The survey brought to light the practices of various sowing proportions of population mixtures of crop and weed taxa, ranging from instances where chicory not only dominated in the berseem fields, but even it is becoming the exclusive choice of farmers for fodder production, reason being that berseem performed poorly in specific location (Satsangi and Gautam, 1983).

The co-flowering nature of the crop and weed demands a comprehensive understanding of the reproductive biology and the interrelationships of berseem crop-chicory weed-insect pollinator complex, to evolve an eco-friendly pollination management strategy towards enhancing seed yields (Daphni 1992; Arroyo, 1981).

On the basis of sampling studies with quadrats, it is estimated that in berseem (cv Wardan) on an average there are about 1.39 million inflorescences/hectare which amount to about 132.34 million flowers/ha. In the experimental farm, about 62.66 insect visitors/m^2/5 min were observed. The honeybee took about 13.65 seconds/ inflorescence and paid visits to about 21.125 inflorescences/ 5 min, whereas the butterfly visited 16.75 berseem inflorescences/5 min. The average pollen load on stigma and its immediate neighbourhoods was about 65.05, however, contamination with other pollen species was not observed as the insect species confined to the same species in the field. The vegetative shoots bear about 1.606 inflorescences, and about 112 shoots/m^2 were present. Even though the average number of flowers/ inflorescence was about 95.211, the average number of seed set in open-pollinated fields is depressingly low at 33.19/inflorescence. Extremely low level of bee population to offer tripping services to flowers in the field seems to be the major cause besides ovule/embryo abortions. In caged plants, where honeybee visits were excluded, it resulted in 3.612 seeds per inflorescence (Shukla and Patil, 1985). Chowdhary *et al.* (1966) stated that berseem is a self-pollinated crop but tripping by honey bee is essential for seed-setting.

In chicory, about 109.83 capitula/plant were recorded with each head inflorescence having 13.35 florets. It is highly self-incompatible and cross-pollinated. Kumar *et al.* (1993) recorded about 17 insect species from 13 genera and 9 families visiting the flowers and *Bombus* species were the most abundant and honeybees were not seen visiting chicory. Insect foraging activity was confined to the forenoon only, as the flowers changed color and closed the petals in the afternoon while the berseem bloom persisted throughout the day on the plant. Butterflies preferred to visit chicory in the morning session and the berseem flowers the rest of the day. The average seed setting in chicory is 9.1/capitulum, which holds about 13.35 florets/capitulum.

The results indicate that berseem and chicory do not compete for the insect pollinator. On the other hand, together they help in enhancing the pollinator biodiversity in the field. Chicory seed yield did not suffer from under-pollination, whereas for berseem, accommodating beehive boxes in the field is necessary for achieving higher and quality seed-yield and also generating supplementary income to the farmer through honey production. United States of America, Canada and New Zealand studies indicate that chicory can be a potential forage crop along with grasses/legumes. Optimization of agronomic practices for legume-chicory combinations and reorientation of breeding and improvement strategies towards it are the need of the hour in the Indian context (Kunelius and Mac Rae, 1999).

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Oil and Erucic Acid Content in Oilseed Crucifers

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Key Words: *Brassica* species, Crucifer, Erucic acids, Oil percentage

The fatty acid composition of the crucifer oil is genetically more variable than probably the composition of any other major vegetable oil (Matti, 1993). Palmitic, stearic, oleic, linoleic, linolenic, eicosenoic and erucic acid are the major fatty acids present in the oil extracted from members of family Cruciferae. Fatty acids are formed by step-wise biosynthetic pathway in which oleic acid either undergoes decreasing saturation to form linoleic acid and then linolenic acid or there is further chain elongation to form eicosenoic acid and then to erucic acid. Crucifers, compared to other oilseed crops are quite unique for exhibiting very high proportion of erucic acid (anti-nutritional factor). Erucic acid constitutes about 50% of the total fatty acids. It is considered as anti-nutritional because heavy accumulation of triglycerides and cholesterol esters containing erucic acid is observed in the heart of the rats fed with rapeseed oil (Saur and Kramer, 1983). This is mainly because erucic acid is metabolically inert, as it does not enter into the β-oxidation pathway to produce ATP (Joyee, 1978). Ziemlanski *et al.* (1995) also concluded some harmful effects of high erucic rapessed oil on the body. Although major breakthrough has been achieved with the production of low erucic acid and also low linolenic acid rapeseed varieties (Prevot, 1990) but most of the accessions with lower erucic acid are not acceptable for commercial production partially because of late maturity and lower oil yield under normal cultivation practices (Rucker and Robblen, 1996).

In the present communication, 153 accessions of different *Brassica* and alien species were studied for their total oil percentage and erucic acid concentration. Erucic acid content of species as well as high and low erucic acid containing *B. napus* lines were compared on the basis of their mean values.

One hundred and fifty three collections of rapeseed-mustard were built up through introduction, exchange and exploration activities of NBPGR, New Delhi. Germplasm comprising of *Brassica juncea* (47), *B. napus* (17), *B. campestris* var. *yellow sarson* (30), *B campestris* var. *toria* (17), *B campestris* var . brown sarson (12), *B. carinata* (4), *B. nigra* (7), *B. rapa* (1), *Eruca sativa* (6), *Sinapis alba* (4), *Crambe abyssinica* (1), *B. juncea* ssp *rugosa* (1), *B. chinensis* (3), *Raphanus caudatus* (1) and *Raphanus sativus* (2), were grown during *rabi* season 1999-2000 at Issapur experimental farm, NBPGR, New Delhi. Three rows of each accessions were planted with recommended basal dose of fertilizer, following normal cultural practices and plant protection measures. Seeds were harvested when plants attained complete physiological maturity. The data on five plants in each genotype was recorded. The mature seed were used for oil and fatty acid analysis. The presented data are the mean of analysis performed in triplicate. Seeds were dried to 4-5% moisture level in oven at 108°C for 16-18 h. The oil content of the seed samples were determined by non-destructive method using Newport NMR analyzer