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Agronomic evaluation of mustard (*Brassica juncea* L.) hybrids under agro-climatic conditions of Prayagraj (U.P.)

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Abstract
Field experimentation was conducted during rabi 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The treatments which are URM-1, URM-2, URM-3, URM-4, URM-5, URM-6, URM-7 and URM-8 hybrids were used. The research was laid out in randomized Block Design with eight treatments each replicated three times. In that study maximum plant height (247.23 cm), plant dry weight (38.97 g/plant), crop growth rate (2.33 g/m^2/day), relative growth rate (0.02g/g/day), length of siliquae (5.40 cm), no. of siliquae per plant (508.80), no. of grains per siliquae (13.60), test weight (5.80 g), seed size (2.20 mm), seed yield (2356.67 kg/ha), stover yield (3523.33 kg/ha) and harvest index (40.10%) were recorded with URM-1 hybrid.

Keywords: Mustard, hybrids, agronomic evaluation, growth, yield

Introduction
India is among the largest vegetable oil economies in the world next only to USA, China and Brazil. The oilseed sector constitutes an important determinant of agricultural economy in the country. The increasing population coupled with rise in income led to higher demand of edible oils. Rapeseed-mustard after China and Canada, accounted for 16% of the global production.. However, the principle growing countries are Bangladesh, Central Africa, China, India, Japan, Nepal and Pakistan as well as Southern Russia in north of the Caspian Sea (Kumar *et al*., 2016). Mustard (*Brassica spp.*) is the third important oilseed crop in the world after soybean and groundnut, respectively. In India, mustard is the second important edible oil seed after groundnut. Rapeseed and mustard are the major oilseed crops. It is traditionally grown everywhere in the country due to it's high adaptability in conventional farming systems. The oil obtained is the main cooking medium in northern India cannot be easily replaced by any other edible oil. The oilcake is mostly used as a cattle feed. The leaves of young plants are used as a green vegetable. The use of mustard oil for industrial purposes is rather limited on account of its high cost.

In Uttar Pradesh rapeseed and mustard is one of the major grown crop occupying 0.56 million ha of area with production and productivity of 0.699 million tonnes and 1,248 kg/ha, respectively. The seed and oil of mustard have a peculiar pungency due to presence of glucosinolate and its hydrolysis products such as Allyl Isothiocynate (0.30-0.35%). The productivity of the crop in the state (1,066 kg/ha) is quite lower than developed countries mainly due to cultivation of age-old varieties having low yield potential (De *et al.,* 2014, Directorate of agriculture, 2014-15).

In agriculture and gardening, hybrid seeds is produced by cross-pollinated plants. Hybrid seed production is predominant in modern agriculture and home gardening. It is one of the main contributors to the dramatic rise in agriculture output during the last half of the 20th century. All of the hybrid seed planted by the farmer will produce similar plants while the seed of next generation from those hybrids will not consistently have the desired characteristics. Hybrids are chosen to improve the characteristics of the resulting plants, such as better yield, greater uniformity, improved colour, disease resistance.

Materials and Methods
The experiment was conducted during the *rabi* season of 2020-2021 at the Crop Research

Farm, Department of Agronomy, SHUATS, Prayagraj. The Crop Research Farm is situated at 25^0 57' N latitude, 87^0 19' E longitude and 98 m altitude from the sea level. This area is situated on the right side of the river *Yamuna* and by the opposite side of Prayagraj city. All the facilities required for crop cultivation are available. The experiment was laid out in Randomized Block Design, containing of eight treatments with different hybrids which are URM-1, URM-2, URM-3, URM-4, URM-5, URM-6, URM-7 and URM-8 which were replicated thrice.

The experimental site was uniform in topography and sandy loam in texture, basal in soil reaction (P^H 8.29), low in Organic carbon (0.20%), medium available N (190.6 kg ha^{-1}), higher available P (37 kg ha^{-1}) and medium available K (100 kg ha^{-1}). Nutrient sources were Urea, DAP and Mop to fulfill the requirement of Phosphorus and potassium. The used fertilizers were applied as basal at the time of seeding. Ten days after the sowing gap filling was done and irrigation given at frequent intervals. In the period from germination to harvest several plant growth parameters were recorded at frequent intervals along with it after harvest several yield parameters were recorded those parameters are plant height (cm), plant dry weight (g/plant), Crop growth rate (g/m^2/day), Relative growth rate (g/g/day), Length of siliquae (cm), No. of siliquae per plant, No. of grains per siliquae, Test weight (g), Seed size (mm), Seed yield (t/ha), Stover yield (t/ha) and Harvest index (%) were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design (Gomez K.A. and Gomez A.A. 1984) [3].

Results and Discussion

Growth parameters of Mustard (*Brassica juncea* L.) hybrids under Agro-climatic conditions of Prayagraj (U.P.)

Data in Table 1 were tabulated the plant height (cm), plant dry weight (g/plant), Crop growth rate (g/m^2/day), Relative growth rate (g/g/day) of mustard and there was increasing in crop age growth parameters were improved with the advancement of experimentation.

Table 1: Growth parameters of Mustard hybrids under Agro-climatic conditions of Prayagraj (U.P.)

Treatments	Plant height (cm)	No. of Primary Branches/plant	No. of Secondary branches/plant	Days to 50% flowering	Plant dry weight (g)	C.G.R (g/m^2/day)	R.G.R (g/g/day)
	At harvest	At harvest	At harvest		At harvest	80- till harvest	80- till harvest
1. URM-1	200.37	6.87	14.17	40.33	38.97	2.26	0.02
2. URM-2	179.97	8.1	18.23	37.00	37.00	1.07	0.01
3. URM-3	208.73	8.53	18.57	15.67	35.33	2.00	0.01
4. URM-4	247.23	7.2	18.87	17.33	35.27	1.47	0.01
5. URM-5	203.33	7.43	13.33	36.00	34.33	2.33	0.01
6. URM-6	211.23	7.47	14.77	41.33	33.83	0.73	0.01
7. URM-7	209.43	6.77	16.77	36.00	32.37	1.39	0.01
8. URM-8	239.97	6.44	13.33	35.33	30.07	2.04	0.01
F test	S	S	S	S	S	S	NS
SEm (+)	2.57	0.4	0.69	0.84	1.18	0.49	0.006
CD (5%)	7.79	1.23	2.11	2.56	2.53	1.5	-

Significantly higher plant height was recorded in hybrid T4 - URM-4 (247.23 cm) however URM-8 (239.97 cm) was found to be statistically at par with T_4 - URM-4 hybrid. The hybrid URM-4 attained maximum plant height at all the stages of crop growth and tallest plant of hybrid URM-4 followed by URM-8 was mainly due to the varietal characteristics. The above findings are supported by Archana kumari *et al*., 2009 [1]. Primary branches per plant, at harvest was recorded significantly higher in treatment URM-3 (8.53) however URM-2 (8.10), URM-5 (7.43) and URM-6 (7.47) were found statistically at par with URM-3. Secondary Branches per plant, at harvest maximum primary branches were recorded in treatment URM–4 (18.87), URM-2 (18.23), URM-3 (18.57) and URM-7 (16.77) which were statistically at par with URM-4. The higher number primary and secondary of branches in URM 3 during maturity was primarily because of higher LAI which increases the total energy available for formation of branches there by higher dry matter accumulation. These findings are supported by Singh, 1989 [2] and Raquiballah *et al*., 2006 [4]. Minimum days taken by URM-3 with (15.67 days) and maximum days to 50% flowering was observed in URM-6 with (41.33 days). The Different varieties of mustard had significant influence on flowering characters at productive part flowering development stages which might be due to different crop growth maturity pattern in complete life cycle growth period. These findings are supported by Kumar *et al.*, 2017 [6]. Maximum plant dry weight was recorded in hybrid T_1, URM-1 (38.97 g) however URM-2 (37.00) was found to be statistically at par with T_1 URM-1 hybrid. At maturity total dry matter per plant was significantly higher in Hybrid URM-1 followed by URM -2 which may be due to the longer duration of crop growth and higher LAI during later stages of its growth which was true indicative of photosynthetic production. Significantly higher C.G.R was recorded in treatment URM-5, (2.33 g/m^2/day) when compare to other treatments except treatment with URM-1, URM-2, URM-3, URM-4, URM-6, URM-7 and URM-8 were found to be statistically at par with T_5 - URM-5 hybrid. At maturity the crop growth rate was higher in hybrid UMR-5 followed by hybrid UMR-1 which was due to higher dry matter production at respective stages of crop growth due to difference in dry matter accumulation. The physiological growth parameters like CGR and RGR differ significantly. These findings are supported by Singh 1989 [2] and Raquibullah *et al.* 2006 [4]. Relative growth rate, at harvest was recorded in hybrid URM-1 (0.02 g/g/day) URM-1 and all other treatments recorded with (0.01 g/g/day).

Table 2: Yield parameters of Mustard hybrids under Agro-climatic conditions of Prayagraj (U.P.)

Treatments	No. of Siliquae per plant	No. of grains per plant	Length of Siliquae (cm)	Test weight (g)	Seed Size (mm)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1. URM-1	5.40	508.80	13.60	5.80	2.20	2.35	3.52	40.10
2. URM-2	4.60	369.53	12.93	5.53	2.03	2.25	3.48	39.24
3. URM-3	4.77	302.47	12.53	5.20	2.03	2.12	3.42	39.46
4. URM-4	4.70	441.17	13.00	4.93	2.00	2.11	3.52	38.23
5. URM-5	4.67	364.13	13.23	5.67	1.93	2.08	3.40	37.41
6. URM-6	5.17	370.27	13.40	4.63	2.03	1.91	3.50	35.32
7. URM-7	4.15	223.00	11.80	4.33	2.03	1.89	3.30	36.39
8. URM-8	4.83	314.00	12.87	5.03	1.93	1.95	3.45	36.13
F test	S	S	S	S	S	S	S	S
SEm (+)	0.10	29.69	0.16	0.28	0.06	0.06	0.04	1.085
CD (5%)	0.31	90.07	0.49	0.84	0.29	0.19	0.13	3.29

Fig 1: Germination test

Fig 2: Sowing

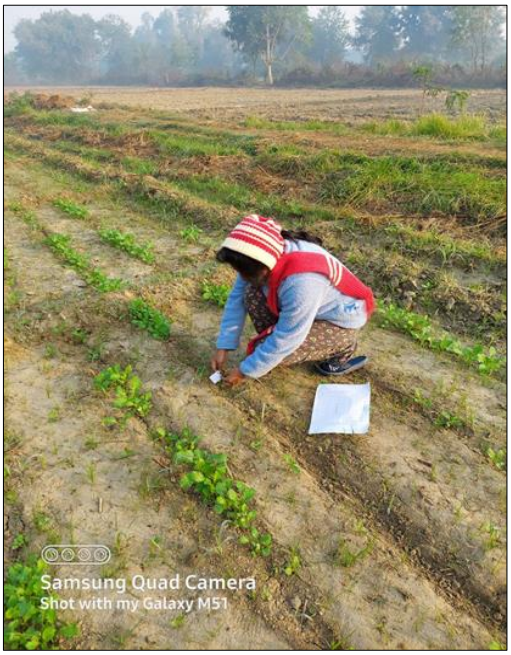

Fig 3: Tagging of plants

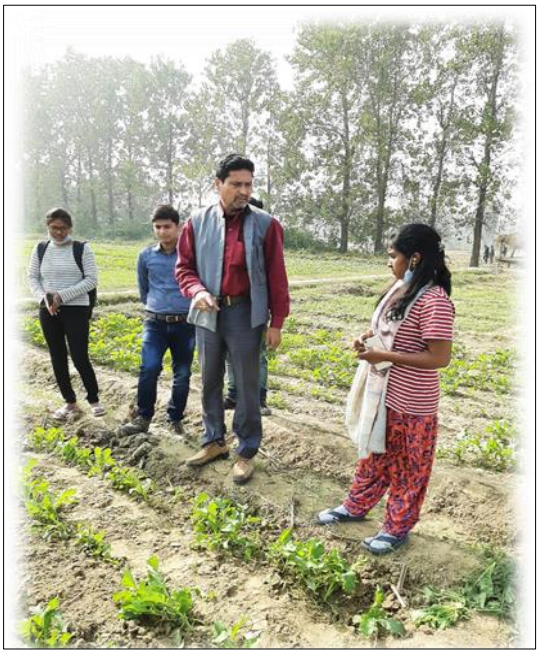

Fig 4: Inspection by Advisor Sir

Fig 5: Field inspection by Advisor sir at harvest

Yield parameters of Mustard (*Brassica juncea* L.) hybrids under Agro-climatic conditions of Prayagraj (U.P.)

Data in Table 2 tabulated the Length of siliquae (cm), No. of siliquae per plant, No. of grains per siliquae, Test weight (g), Seed size (mm), Seed yield (t/ha), Stover yield (t/ha) and Harvest index (%) of mustard and there was increasing in yield parameters were improved at harvest of experimentation.

Significantly higher the number of siliquae/plant was recorded in hybrid URM-1 (508.80/plant) was found to be statistically at par with hybrid URM-4, the number of siliquae/ plant were highest in hybrid UMR-1 due to higher dry matter production. Significantly higher the number of grains/siliquae of mustard maximum grains/siliquae was recorded in hybrid URM-1(13.60) was found to be statistically at par with hybrid URM- 6 and URM-5. Larger the siliquae more the grains per siliquae and higher test weight were recorded in main shoot followed by primary and secondary branches in hybrid UMR-1. Significantly higher the length of the siliquae of mustard maximum length of the siliquae was recorded in hybrid URM-1 (5.40 cm) was found to be statistically at par with hybrid URM-6. Among the cultivars hybrid URM-1 had higher siliquae, length and more number of grains per siliquae followed by Hybrid URM-6. Significantly higher the maximum test weight of mustard was recorded in hybrid URM-1(5.80g) was found to be statistically at par with hybrid URM-5, URM-2, URM-3 and URM-8. Significantly higher the highest test weight was recorded in hybrid URM-1 which was primarily due to higher number of branches and siliquae per plant. The hybrid URM-1 recorded significantly higher seed size of mustard grain (2.20) was found to be statistically at par with hybrid URM-2, URM-3, URM-4, URM-6 and URM-7. The varietal differences of yield attributes has also been reported by Prakash *et al*., 2000, Roy *et al*., 2005, Singh *et al*., 2006 and Razzaque *et al*., 2007 [5]. Significantly higher the maximum seed yield of mustard was recorded in hybrid URM-1 (2356.67 kg/ha), however the lowest seed yield was recoded in URM-7 (1890.67 kg/ha) of mustard hybrids. The hybrid URM-1 recorded significantly highest seed yield this might be due to higher number of branches, siliqua and highest seed weight per plant. The varietal differences in seed yield has also been reported by Singh *et al*., 2001, Raquibullah *et al*., 2006 [4], Razzaque *et al*., 2007 [5] and Dehghani *et al*., 2008. Significantly higher the maximum stover yield of mustard was recorded in hybrid URM-1 (3523.33 kg/ha). however the lowest stover yield was recorded in URM-7 (3300 kg/ha) of mustard hybrids. The stover yield was highest in the treatment URM-1 due to higher dry matter accumulation in that hybrid. Significantly higher the maximum harvest index of mustard was recorded in hybrid URM-1 (40.1%), however the lowest harvest index was recorded in URM-8 (36.13) of mustard hybrids. The harvest index was scientifically highest in the hybrid URM-1 due to its highest seed yield and biological yield.

Conclusion

On the basis of experimentation the results can be concluded that treatment T1 (URM-1) recorded maximum productive grain yield (2356.67 kg/ha), and was also economically profitable (71,942 INR/ha).

The conclusion drawn are based on only one season data which requires further confirmation for recommendation.

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