

Comparative Performance Trial of Three Mustard Varieties under Mid-Altitude Conditions of Tsirang

1. Introduction



Mustard (*Brassica juncea* L.) is one of the most important oilseed crops cultivated in Bhutan, contributing significantly to household food security, rural livelihoods, and the national edible oil supply. Its adaptability to diverse agro-ecological zones makes it a promising crop for mid-altitude regions, where climatic conditions favour both vegetative growth and seed development. However, varietal performance often varies with elevation, temperature, and soil fertility, necessitating systematic evaluation to identify high-yielding and stable cultivars suited to specific environments.

An on-station (ARDSC, Tsirang) mustard performance evaluation trial was conducted at an elevation of 1500 meters above sea level (masl) to assess the yield potential of three mustard varieties: Yusipeka-1, Yusipeka-2, and M-27. The primary objective of this trial was to compare their agronomic performance under mid-altitude conditions, with a particular focus on seed yield, as yield stability and productivity are critical determinants for varietal recommendation and adoption, thereby supporting farmers in enhancing productivity and strengthening mustard cultivation in similar agro-ecological zones.

2. Materials and Methods

The on-station performance evaluation trial was carried out at the research farm located at 1500 meters above sea level (masl), representing typical mid-altitude agro-ecological conditions. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications to minimize environmental variation and ensure reliable comparison among varieties.

The three mustard varieties under evaluation were Yusipeka-1, Yusipeka-2, and M-27. Each plot measured 2 m × 5 m, with a spacing of 30 cm between rows and 10 cm between plants within rows was maintained. Standard agronomic practices, including land preparation, basal fertilizer application, and timely weeding, were uniformly applied across all plots to maintain consistency.

Data collection focused primarily on yield performance, measured as seed yield per plot and extrapolated to kilograms per acre. In addition, supporting agronomic traits such as plant height, number of siliquae per plant, siliquae length, seeds per siliquae and days to maturity were recorded to provide context for yield differences. Statistical analysis was conducted using analysis of variance (ANOVA) with Tukey's HSD for post hoc comparisons, and Pearson's correlation to examine trait relationships with yield.

3.Result and Discussion

3.1. Overview of data range for all traits of three varieties

	Plant			No. Of Siliquae / plant			Siliquae length			seed s/ siliquae			Yield		
	Height(cm)														
	Yusi peka-1	Yusi Peka-2	M-27	Yusi peka-1	Yusi Peka-2	M-27	Yusi peka-1	Yusi Peka-2	M-27	Yusi peka-1	Yusi Peka-2	M-27	Yusi peka-1	Yusi Peka-2	M-27
SD	13.2	7.5	3.6	32.6	9.2	47.1	1.5	0.8	0.6	29.4	3.2	2.1	0.3	0.2	0.3
Average	79	104	99	96.7	42.0	95.7	4.9	4.8	4.6	57.0	22.3	17.3	1.0	1.1	1.1
Minimum	64	96	95	61	34	68	3.8	4	4	23	20	15	0.7	0.8	0.7
Maximum	89	111	102	125	52	150	6.6	5.5	5.1	74	26	19	1.3	1.2	1.3

Table 1. Range for different traits for all varieties

3.2. Anova (analysis of variances)

3.2.1. Post Hoc Comparisons (plant Height(cm))

		Mean Difference	SE	df	t	Tukey
(M-27)	(Yusi Peka-2)	-5.000	7.379	6	-0.678	.784
	(Yusi peka-1)	20.00	7.379	6	2.711	.078
(Yusi Peka-2)	(Yusi peka-1)	25.00	7.379	6	3.388	.034

Table 2. Post Hoc test for plant height among three varieties

The analysis of variance showed significant differences in plant height among varieties ($F = 6.429$, $p = 0.032$). Tukey's HSD post hoc test indicated that Yusi Peka-2 plants were significantly taller than Yusi Peka-1 (mean difference = 25 cm, $p = 0.034$). No significant differences were observed between M-27 and the other varieties, although M-27 tended to be taller than Yusi Peka-1 (mean difference = 20 cm, $p = 0.078$).

3.2.2. Number of seeds/ siliquae

Cases	Sum of Squares	df	Mean Square	F	p
variety	5870	2	2935	2.618	.152
Residuals	6725	6	1121		

Table 3. Anova test for number of seed per siliquae for all varieties

The analysis of variance showed no significant differences among varieties for the number of seeds per siliquae ($F = 2.618$, $p = 0.152$).

3.2.3. Siliquae length

Cases	Sum of Squares	df	Mean Square	F	P
variety	0.136	2	0.068	0.066	.937
Residuals	6.207	6	1.034		

Table 3. Anova test for siliquae length for all varieties

An analysis of variance (ANOVA) was conducted to assess differences in siliquae length among the three mustard varieties and the results showed that the effect of variety on siliquae length was not statistically significant ($F = 0.066$, $p = 0.937$).

3.2.4. Number of Siliquae/ plants

Cases	Sum of Squares	df	Mean Square	F	P
variety	5870	2	2935	2.618	.152
Residuals	6725	6	1121		

Table 4. Anova test for number of siliquae per plant for all varieties

An analysis of variance (ANOVA) showed that the effect of variety was not statistically significant ($F = 2.618$, $p = 0.152$) for number of siliquae per plant among three varieties.

3.2.5. Yield

Cases	Sum of Squares	df	Mean Square	F	p
variety	0.018	2	0.009	0.118	.890
Residuals	0.456	6	0.076		

Table 5. Anova test for yield performance of all three varieties

The analysis of variance showed no significant differences among varieties for yield ($F = 0.118$, $p = 0.890$) suggesting that the varieties produced statistically similar yields under the trial conditions.

3.3. Corelation among traits with yield

Pearson's Correlations

			Pearson's r	p
Plant Height(cm)	-	No. Of Siliquae/ plant	-0.328	.389
Plant Height(cm)	-	Yield	0.465	.208
Plant Height(cm)	-	Siliquae length	0.314	.411
Plant Height(cm)	-	seeds/ siliquae	-0.796	.010
No. Of Siliquae/ plant	-	Yield	0.043	.913
No. Of Siliquae/ plant	-	Siliquae length	0.086	.825

Pearson's Correlations

			Pearson's r	p
No. Of Siliquae/ plant	-	seeds/ siliquae	0.012	.976
Yield	-	Siliquae length	-0.161	.679
Yield	-	seeds/ siliquae	-0.068	.861
Siliquae length	-	seeds/ siliquae	-0.368	.330

Table 5. Correlation among all traits

Pearson's correlation analysis revealed that plant height was strongly and negatively correlated with the number of seeds per siliqua ($r = -0.796$, $p = 0.010$), indicating that taller plants tended to produce fewer seeds per siliqua. Other correlations, including plant height with yield ($r = 0.465$, $p = 0.208$) and siliquae per plant with yield ($r = 0.043$, $p = 0.913$), were weak and not statistically significant. Yield also showed no significant associations with siliquae length or seeds per siliquae.

Conclusion

The mustard performance evaluation trial at ARDSC Tsirang revealed that Yusipecta-1, Yusipecta-2, and M-27 produced statistically similar yields under mid-altitude conditions. Although Yusipecta-2 exhibited significantly taller plant height compared to Yusipecta-1, this trait did not translate into yield advantage. Similarly, siliquae number and siliquae length showed no significant varietal differences, suggesting these traits are not reliable indicators of yield potential.

Overall, the trial demonstrates that all three mustard varieties are equally suitable for cultivation in mid-altitude agro-ecological zones of Bhutan. Farmers may therefore select varieties based on other desirable attributes such as maturity duration or seed quality rather than yield alone.

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