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Multilocation Trails for Stability of Reproductive Characters of Horsegram Mutants

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Abstract: ***Stability of reproductive characters such as pods per plant, pod length (cm), seeds per pod, 1000 seed weight (g) and seed yield per plant (g) in horsegram [(Macrotyloma uniflorum (Lam.) Verdc] mutants was evaluated by conducting multi-location trials at different localities. Trails are important for evaluation of genotype by environment interaction and identification of superior genotypes in the final selection cycles. Multilocation trials are often used to analyse the adaptability of genotypes in different environments and to find for each environment the genotype that is best adapted. The objective of this study was to evaluate stability and adaptability of reproductive characters of horsegram mutants. Multilocation trails of horsegram mutants were conducted at different localities of five districts of Maharashtra such as 1. Pokhari (Tal-Ashti, Dist-Beed), Chinchpur, Tal-Paranda, Dist- Osmanabad), 3. Hulgewadi (Tal- Karmala, Dist- Solapur), 4. Kuldharan (Tal- Karjat, Dist- Ahmednagar) and Pimpalwadi, (Tal-Kankavali, Dist- Sindhudurg). The stability of reproductive parameters in M_4, M_5 and M_6 generations was investigated. Almost all mutants like early dwarf, early semi dwarf, late and high yielding showed stability in all generations at five localities in five districts of Maharashtra.***

Keywords: Horsegram, reproductive characters, generations, stability, mutants.

I. INTRODUCTION

In India horsegram [*Microtyloma uniflorum* (Lam.) Verdc.] is cultivated on a large acreage. It is highly suitable for rainfed and marginal agriculture. It is a drought-tolerant plant and can be grown with low rainfall. (Chahota et al., 2013). Horsegram is a leguminous crop which improves soil fertility by fixing atmospheric nitrogen hence it is used as a green manure and cover crop. It is a 'neglected' crop and farmers' choice of varieties to grow is limited to poor-yielding landraces or to modern varieties for which access to seed is limited (Virk et al., 2006). It has medicinal properties for treatment of kidney diseases and urinary problems (Bolbhat and Kamble, 2015).

Seed yield in horsegram is a complex character and is determined by various components. For selection, one should understand the yield component characters and the direct and indirect effects of various component characters on seed yield (Alle et al., 2016). Reproductive characters are an important criteria in crop improvement programmee. Many mutants showed good reproductive characters in horsegram. But inhibitory effects on reproductive characters by mutagens have also been reported by Bolbhat and Dhumal in horsegram (2009).

Many traits of agronomic importance are controlled by multiple genes of small effect, while their phenotypic expressions is strongly affected by non-genetic factors by environment interactions (Piepho, 1994). The evaluation of new cultivars is usually done by multilocation trials which are essential for obtaining well adapted cultivars (Piepho, 1994). Stability of reproductive characters such as pods per plant, pod length (cm), seeds per pod, 1000 seed weight (g) and seed yield per plant (g) in horsegram mutants was evaluated by conducting multi-location trials at different localities. Trails are important for evaluation of genotype by environment interaction and identification of superior genotypes in the final selection cycles. Therefore the present investigation was undertaken to study the stability of reproductive characters of horsegram mutants at different localities in different districts of Maharashtra.

II. MATERIALS AND METHODS

Multilocation trails were conducted to study the stability of reproductive characters such as pods per plant, pod length (cm), seeds per pod, 1000 seed weight (g) and seed yield per plant (g) in horsegram mutants at different localities. The seeds of horsegram mutants such as early dwarf, early semi dwarf, late and high yielding were obtained from Department of Botany, Rayat Shikshan Sanstha's Dada Patil Mahavidyalaya Karjat, Dist- Ahmednagar- 414402 (MS). The seeds of each mutant (675) were sown in a field at a spacing of 30 x 15cm in randomized block design (RBD) replicated thrice with control for rising M_4 generation. The field experiment was conducted at different localities of Maharashtra like 1.

Pokhari (Tal-Ashti, Dist-Beed), Chinchpur, Tal-Paranda, Dist- Osmanabad), 3. Hulgewadi (Tal- Karmala, Dist- Solapur), 4. Kuldharan (Tal- Karjat, Dist- Ahmednagar) and Pimpalwadi, (Tal-Kankavali, Dist- Sindhudurg). M_4 populations were observed for stability of reproductive characters such as pods per plant, pod length (cm), seeds per pod, 1000 seed weight (g) and seed yield per plant (g) in horsegram.

Mean values of growth parameters were recorded in the table. All the M_4 mutant plants were harvested individually. Seeds obtained in M_4 generation were used to raise M_5 followed by M_6 generations in following rainy seasons at same localities.

A. Statistical Analysis

The data were summarized as the means of three replicates with standard deviation as the measures of variability. One-way ANOVA test was performed to determine significant differences due to various treatments. Fisher's LSD (Least significant difference) was used as post hoc test to as certain significant differences among treatments at p= 0.05. Statistical analysis and graphical data presentations were carried out by using Sigma stat (ver.25).

III. RESULTS AND DISCUSSION

Horsegram mutants such as early dwarf, early semi dwarf, late and high yielding were planted at different places of five districts of Maharashtra. Data obtained on mean reproductive characters such as pods per plant, pod length (cm), seeds per pod, 1000 seed weight (g) and seed yield per plant (g) of all mutants and control presented in Table. It clearly indicates that the reproductive characters were stable with minor variation in all the mutants and at all localities.

1) *Early Dwarf Mutant:* In M_4 generation the range of pods per plant, at all places was 31.17 to 36.21, while in M_5 generation 30.21 to 37.36 and in M_6 generation 38.20 to 51.29 was recorded. Maximum pods per plant was noted 51.29 at Pimplewadi in M_6 generation. The range of seeds per pod, at all places in M_4 generation was 6.13 to 6.23, in M_5 generation 6.13 to 6.31 and in M_6 generation 5.61 to 6.09 was recorded. In M_5 generation maximum 6.31 seeds per pod was noted at Pimplewadi. 5.30 to 5.49, 5.21 to 5.50 and 5.01 to 5.30 (cm) were the range of pod length (cm) at all localities in M_4, M_5 and M_6 generations respectively. At Pimplewadi maximum pod length was recorded (5.50cm) in M_5 generation. In M_4, M_5 and M_6 generations the range of 1000 seed weight (g), at all places was 26.33 to 28.11, 26.19 to 28.19 and 23.22 to 26.05 (g) were recorded respectively. Maximum 1000 seed weight (g) was noted 28.19 in M_5 generation at Pimpalwadi. The range of seed yield per plant, at all places in M_4 generation was 9.35 to 10.62, in M_5 generation 9.18 to 10.92 and in M_6 generation 8.11 to 8.91 was recorded. In M_5 generation maximum 10.92 (g) seeds per pod was noted at Pimplewadi. Data recorded in table revealed that in M_4 to M_6 generations. At all localities the reproductive characters show stability in the cultivars with minor variations.

2) *Early Semi Dwarf Mutant:* Pods per plant of early semi dwarf mutant at all localities in M_4, M_5 and M_6 generations was ranged in between 35.19 to 41.39, 32.09 to 39.69 and 39.48 to 53.80 respectively. In M_4 generation the range of seeds per pod, at all places was 6.27 to 6.45, while in M_5 generation 6.29 to 6.49 and in M_6 generation 5.86 to 6.32. In M_5 generation at Pimplewadi, maximum seeds per pod (6.49) was recorded. At all localities, pod length (cm) in M_4, M_5 and M_6 generations were ranged in between 5.41 to 5.56 , 5.25 to 5.57 and 5.04 to 5.41 (cm) respectively. Highest pod length (cm) was 5.57 at Pimpalwadi in M_5 generation. 26.10 to 27.32, 26.11 to 27.35 and 23.09 to 26.14 (g) was the range of 1000 seed weight (g) in M_4, M_5 and M_6 generations at all places. Maximum (27.35 g) 1000 seed weight (g) was recorded in M_5 generation at Pimplewadi. At all localities, seed yield per plant (g) in M_4, M_5 and M_6 generations were ranged in between 9.29 to 10.31, 9.05 to 10.49 and 8.30 to 9.10 (g) respectively. Highest seed yield per plant (g) was 10.49 g at Pimpalwadi in M_5 generation. Almost all mutants in all generations and at all places showed stability with respect to reproductive characters.

3) *Late Mutant:* The results of present study (Table) have clearly shown that late mutant was sensitive to reproductive characters at all localities. Almost at all localities and in all generations late mutant showed increased reproductive characters over control. Maximum pods per plant was recorded in M_5 generation at Pimpalwadi 88.70. The range of pods per plant, at all localities was 75.19 to 79.85, 73.27 to 88.70 and 65.69 to 81.07 in M_4, M_5 and M_6 generations. In M_4 generation the range of seeds per pod, at all places like 7.15 to 7.19, while in M_5 generation 7.12 to 7.34 and in M_6 generation 7.15 to 7.29 was recorded. At Pimplewadi maximum seeds per pod was noted in M_5 generation (7.34). At all localities the range of pod length (cm) were noted such as 6.11 to 6.30, 6.03 to 6.35 and 6.11 to 6.12 in M_4, M_5 and M_6 generations. 27.43 to 28.30, 27.13 to 28.33 and 24.22 to 26.32 were the range of 1000 seed weight (g), at all places were recorded. Maximum 1000 seed weight (g) was recorded 28.33g in M_5 generation at Pimpalwadi. At all localities, seed yield per plant (g) in M_4, M_5 and M_6 generations were ranged in between 14.31 to 15.49, 14.05 to 15.75 and 13.69 to 14.93(g) respectively. Highest seed yield per plant (g) was 15.75 g at Pimpalwadi in M_5 generation. The minor difference in reproductive characters was caused by environmental factors like soil type, topography, soil nutrients, temperature, rainfall directly affect on reproductive characters.

4) *High Yielding Mutant:* Data obtained on mean pods per plant was increased at all places and in all the generations as compared to control. Highest pods per plant (93.62) in M_5 generation was recorded at Pimpalwadi. In M_4 generation the range of pods per plant, at all places was 79.64 to 84.32, while in M_5 generation 75.62 to 93.62 and in M_6 generation 72.41 to 83.17. The range of seeds per pod, at all trial plots were recorded such as 7.13 to 7.31, 7.09 to 7.31 in M_4, M_5 and M_6 generations. Highest seeds per pod was 7.31 in M_4 and M_5 generation at Pimplewadi. At all localities, the range of pod length (cm) was recorded in M_4, M_5 and M_6 generations such as 6.15 to 6.31, 6.10 to 6.35 and 5.95 to 6.11cm respectively. At Chinchpur, in M_5 generation maximum pod length (cm) was 6.35cm. 28.11 to 28.50, 27.70 to 28.57 and 25.68 to 26.71g were the range of 1000 seed weight (g) at all places in M_4, M_5 and M_6 generations, while the maximum 1000 seed weight (g) was 28.57g in M_5 generation at Pimpalwadi. Data obtained on mean 1000 seed weight was increased at all places and in all the generations as compared to control. Highest seed yield per plant (g) in M_4 generation was recorded at Pimpalwadi (16.33g). In M_4 generation the range of seed yield per plant (g), at all places was 15.13 to 16.33g, while in M_5 generation 14.53 to 16.21g and in M_6 generation 14.85 to 16.02g. All mutants showed significant changes in reproductive characters in all generations and all localities. There were minor variations in reproductive characters. It was mainly due to change in climatic conditions.

IV. CONCLUSION

Almost all mutants showed stability in reproductive characters such as pods per plant, pod length (cm), seeds per pod, 1000 seed weight (g) and seed yield per plant (g) at all locations over control. There were minor variations in reproductive characters at all places in M_4, M_5 and M_6 generations. It was mainly due to change in climatic conditions. Thus multilocation trails provide an effective overview of average performance and environmental stability useful for identifying locations that optimized cultivar performance and for making better use of limited resources available for the testing programme. All these mutants will be used for sowing in all five districts of Maharashtra. It is beneficial to farmers as well as plant breeders.

V. ACKNOWLEDGEMENT

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Table: 1a Multilocation trails for stability of reproductive characters in M_4 generation of horsegram mutants Place- Pokhari, Tal- Ashti, Dist Beed (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	75.67.25±15.44	6.71±0.94	6.80±0.95	25.70±3.60	13.90±1.95
Early dwarf	31.17±4.01	5.43±0.43	6.15±0.49	26.90±2.15	9.51±0.76
Early Semi dwarf	37.61±5.24	5.52±0.61	6.30±0.69	26.10±2.87	9.35±1.03
Late	78.42±10.19	6.11±0.79	7.15±0.93	27.80±3.61	14.42±2.26
High yielding	80.29±11.24	6.15±0.86	7.14±1.00	28.25±3.96	15.93±2.51
SEM ±	8.26	0.61	0.68	2.70	1.50
F-value	19.30	1.46	0.93	0.32	15.18
P-value	0.01	0.29	0.48	0.86	0.01
LSD 0.05	18.00	--	--	--	3.27

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 1b Multilocation trails for stability of reproductive characters in M_4 generation of horsegram mutants Place- Chinchpur, Tal- Paranda, Dist- Osmanabad (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	72.11±15.70	6.82±0.95	6.81±0.95	25.82±3.61	13.95±1.95
Early dwarf	33.65±4.29	5.45±0.44	6.17±0.49	26.95±2.16	9.67±0.77
Early Semi dwarf	38.78±5.37	5.57±0.61	6.33±0.70	26.25±2.89	9.46±1.04
Late	79.85±10.38	6.17±0.80	7.17±0.93	27.85±3.62	14.89±2.27
High yielding	80.90±11.33	6.31±0.88	7.15±1.00	28.29±3.96	15.45±2.50
SEM ±	8.40	0.62	0.68	2.70	1.50
F-value	18.26	1.63	0.91	0.30	14.61
P-value	0.01	0.24	0.50	0.87	0.01
LSD 0.05	18.30	--	--	--	3.27

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 1c Multilocation trails for stability of reproductive characters in M_4 generation of horsegram mutants Place- Hulgewadi, Tal- Karmala, Dist- Solapur (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	70.21±15.43	6.80±0.95	6.78±0.95	25.65±3.59	13.19±1.85
Early dwarf	32.31±4.02	5.30±0.42	6.13±0.49	26.33±2.11	9.35±0.75
Early Semi dwarf	35.19±4.97	5.51±0.61	6.27±0.69	26.18±2.88	9.29±1.02
Late	75.42±9.80	6.11±0.79	7.15±0.93	27.43±3.57	14.31±2.22
High yielding	79.64±10.73	6.25±0.88	7.13±1.00	28.11±3.94	15.13±2.40
SEM ±	8.08	0.62	0.68	2.68	1.45
F-value	20.51	1.90	0.97	0.28	14.52
P-value	0.01	0.19	0.46	0.88	0.01
LSD 0.05	17.61	--	--	--	3.16

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 1d Multilocation trails for stability of reproductive characters in M_4 generation of horsegram mutants
Place- Kuldharan, Tal- Karjat, Dist - Ahmednagar (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	71.12±9.96	6.11±0.86	6.85±0.96	26.75±3.75	13.11±1.98
Early dwarf	35.14±4.41	5.43±0.43	6.22±0.50	27.17±2.17	9.57±0.77
Early Semi dwarf	38.22±5.85	5.41±0.60	6.41±0.71	26.29±2.89	9.47±1.04
Late	75.19±11.07	6.13±0.80	7.18±0.93	28.19±3.66	14.51±2.28
High yielding	81.91±12.31	6.18±0.87	7.15±1.00	28.35±3.97	15.19±2.55
SEM ±	7.55	0.60	0.69	2.74	1.52
F-value	9.26	0.88	0.80	0.21	15.18
P-value	0.01	0.51	0.55	0.92	0.01
LSD 0.05	16.45	--	--	--	3.31

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 1e Multilocation trails for stability of reproductive characters in M_4 generation of horsegram mutants
Place- Pimpalwadi, Tal- Kankavali, Dist - Sindhudurg (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	70.23±11.23	6.15±0.86	6.95±0.97	27.19±3.81	13.20±2.13
Early dwarf	36.21±4.50	5.49±0.44	6.23±0.50	28.11±2.25	10.62±0.85
Early Semi dwarf	41.39±6.31	5.56±0.61	6.45±0.71	27.32±3.01	10.31±1.13
Late	77.91±11.43	6.30±0.82	7.29±0.95	28.30±3.68	15.49±2.40
High yielding	84.32±12.50	6.25±0.88	7.31±1.02	28.50±3.99	16.33±2.71
SEM ±	7.94	0.61	0.70	2.78	1.62
F-value	8.39	0.84	0.99	0.09	13.74
P-value	0.01	0.53	0.46	0.98	0.01
LSD 0.05	17.30	--	--	--	3.53

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 2a Multilocation trails for stability of reproductive characters in M_5 generation of horsegram mutants
Place- Pokhari, Tal- Ashti, Dist - Beed (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	72.30±14.59	6.40±0.90	6.57±0.92	25.21±3.53	13.51±1.89
Early dwarf	30.21±3.62	5.23±0.42	6.14±0.49	26.19±2.10	9.24±0.74
Early Semi dwarf	34.19±4.86	5.45±0.60	6.29±0.69	26.12±2.87	9.19±1.01
Late	73.27±9.53	6.05±0.79	7.12±0.93	27.13±3.53	14.19±2.25
High yielding	75.62±10.59	6.11±0.86	7.14±1.00	27.70±3.88	14.53±2.46
SEM ±	7.77	0.60	0.68	2.65	1.47
F-value	20.53	1.33	0.94	0.27	15.60
P-value	0.01	0.32	0.48	0.89	0.01
LSD 0.05	16.93	--	--	--	3.20

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 2b Multilocation trails for stability of reproductive characters in M_5 generation of horsegram mutants
Place- Chinchpur, Tal- Paranda, Dist- Osmanabad (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	75.31±15.01	6.73±0.94	6.75±0.95	25.61±3.59	13.72±1.92
Early dwarf	31.34±4.11	5.39±0.43	6.13±0.49	26.73±2.14	9.18±0.73
Early Semi dwarf	35.15±4.97	5.51±0.61	6.35±0.70	26.52±2.92	9.05±1.00
Late	73.29±9.53	6.14±0.80	7.20±0.94	27.18±3.53	14.37±2.23
High yielding	82.73±11.58	6.35±0.89	7.19±1.01	28.11±3.94	15.14±2.41
SEM ±	8.10	0.62	0.68	2.68	1.46
F-value	19.11	1.68	1.00	0.23	15.26
P-value	0.01	0.23	0.45	0.91	0.01
LSD 0.05	17.65	--	--	--	3.15

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 2c Multilocation trails for stability of reproductive characters in M_5 generation of horsegram mutants
Place- Hulgewadi, Tal- Karmala, Dist- Solapur (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	71.65±15.78	6.82±0.95	6.81±0.95	25.83±3.62	13.31±1.86
Early dwarf	33.43±4.11	5.26±0.42	6.17±0.49	26.61±2.13	9.40±0.75
Early Semi dwarf	35.32±5.21	5.46±0.60	6.33±0.70	26.11±2.87	9.39±1.03
Late	77.81±10.12	6.07±0.79	7.24±0.94	27.48±3.57	14.91±2.33
High yielding	79.11±11.08	6.31±0.88	7.19±1.01	28.24±3.95	15.11±2.45
SEM ±	8.31	0.62	0.69	2.69	1.48
F-value	19.98	2.12	1.01	0.27	15.66
P-value	0.01	0.15	0.45	0.89	0.01
LSD 0.05	18.11	--	--	--	3.22

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 2d Multilocation trails for stability of reproductive characters in M_5 generation of horsegram mutants
Place- Kuldharan, Tal- Karjat, Dist - Ahmednagar (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	68.19±9.55	6.05±0.85	6.67±0.93	26.25±3.68	13.98±1.96
Early dwarf	30.29±4.02	5.21±0.42	6.18±0.49	27.05±2.38	9.41±0.75
Early Semi dwarf	32.09±5.07	5.25±0.58	6.36±0.70	26.15±2.50	9.12±1.00
Late	78.17±10.16	6.03±0.78	7.15±0.93	28.11±2.97	14.05±2.22
High yielding	81.22±11.37	6.10±0.85	7.09±0.99	28.16±3.17	14.95±2.47
SEM ±	6.98	0.59	0.68	2.72	1.48
F-value	10.47	1.21	0.80	0.25	15.06
P-value	0.01	0.36	0.55	0.90	0.01
LSD0.05	15.21	--	--	--	3.22

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 2e Multilocation trails for stability of reproductive characters in M_5 generation of horsegram mutants
Place- Pimpalwadi, Tal- Kankavali, Dist - Sindhudurg (MS)

Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	83.50±11.69	6.18±0.87	6.97±0.98	27.25±3.82	14.30±2.14
Early dwarf	37.36±4.59	5.50±0.44	6.31±0.50	28.19±2.26	10.92±0.87
Early Semi dwarf	39.69±6.57	5.57±0.61	6.49±0.71	27.35±3.01	10.49±1.15
Late	88.70±11.53	6.35±0.83	7.34±0.95	28.33±3.68	15.75±2.43
High yielding	93.62±13.11	6.27±0.88	7.31±1.02	28.57±4.00	16.21±2.73
SEM ±	8.21	0.61	0.70	2.79	1.64
F-value	8.45	0.89	0.90	0.09	13.33
P-value	0.01	0.50	0.50	0.98	0.01
LSD0.05	17.89	--	--	--	3.57

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 3a Multilocation trails for stability of reproductive characters in M_6 generation of horsegram mutants
Place- Pokhari, Tal- Ashti, Dist Beed (MS)

Mutants	Pods/ plant	Pod Length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	70.21±9.83	6.20±0.87	6.31±0.88	23.32±3.26	12.85±1.80
Early dwarf	38.2±3.06	5.11±0.41	5.81±0.46	23.62±1.89	8.11±0.65
Early semi dwarf	40.27±4.43	5.12±0.56	6.08±0.67	24.28±2.67	8.73±0.96
Late	71.36±9.28	5.89±0.77	6.71±0.87	25.20±3.28	13.92±1.81
High yielding	73.11±10.24	5.95±0.83	6.86±0.96	25.79±3.61	14.97±2.10
SEM±	6.50	58.00	0.65	2.45	1.28
F-value	14.94	1.52	0.91	0.36	11.84
P-value	0.01	0.27	0.50	0.83	0.01
LSD0.05	14.17	--	--	--	2.79

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 3b Multilocation trails for stability of reproductive characters in M_6 generation of horsegram mutants
Place- Chinchpur, Tal- Paranda, Dist- Osmanabad (MS)

Mutants	Pods/ plant	Pod length(cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	68.81±9.63	6.21±0.87	6.11±0.86	21.32±2.98	12.95±1.81
Early dwarf	45.14±3.61	5.10±0.41	5.85±0.47	23.43±1.87	8.18±0.65
Early semi dwarf	41.37±4.55	5.13±0.56	5.92±0.65	23.09±2.54	8.31±0.91
Late	77.69±10.10	5.98±0.78	6.89±0.90	24.22±3.15	13.69±1.78
High yielding	78.12±10.94	6.02±0.84	6.92±0.97	25.81±3.61	14.85±2.08
SEM±	6.81	0.58	0.64	2.36	1.27
F-value	13.59	1.65	1.33	0.96	12.23
P-value	0.01	0.24	0.32	0.45	0.01
LSD0.05	14.85	--	--	--	2.77

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 3c Multilocation trails for stability of reproductive characters in M_6 generation of horsegram mutants
Place- Hulgewadi, Tal- Karmala, Dist- Solapur (MS)

Mutants	Pods/ plant	Pod length(cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	67.72±9.48	6.10±0.85	6.32±0.88	22.14±3.10	12.52±1.75
Early dwarf	43.49±3.48	5.10±0.41	5.92±0.47	23.22±1.86	8.91±0.71
Early semi dwarf	42.63±4.69	5.14±0.57	6.02±0.66	24.03±2.64	9.10±1.00
Late	69.93±9.09	5.29±0.69	6.80±0.88	25.19±3.27	13.74±1.79
High yielding	72.41±10.14	6.03±0.84	6.93±0.97	25.68±3.60	15.10±1.97
SEM±	6.42	0.57	0.65	2.41	1.25
F-value	10.71	1.51	0.97	0.71	8.08
P-value	0.01	0.27	0.46	0.60	0.01
LSD0.05	13.99	--	--	--	2.73

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 3d Multilocation trails for stability of reproductive characters in M_6 generation of horsegram mutants
Place- Kuldharan, Tal- Karjat, Dist - Ahmednagar (MS)

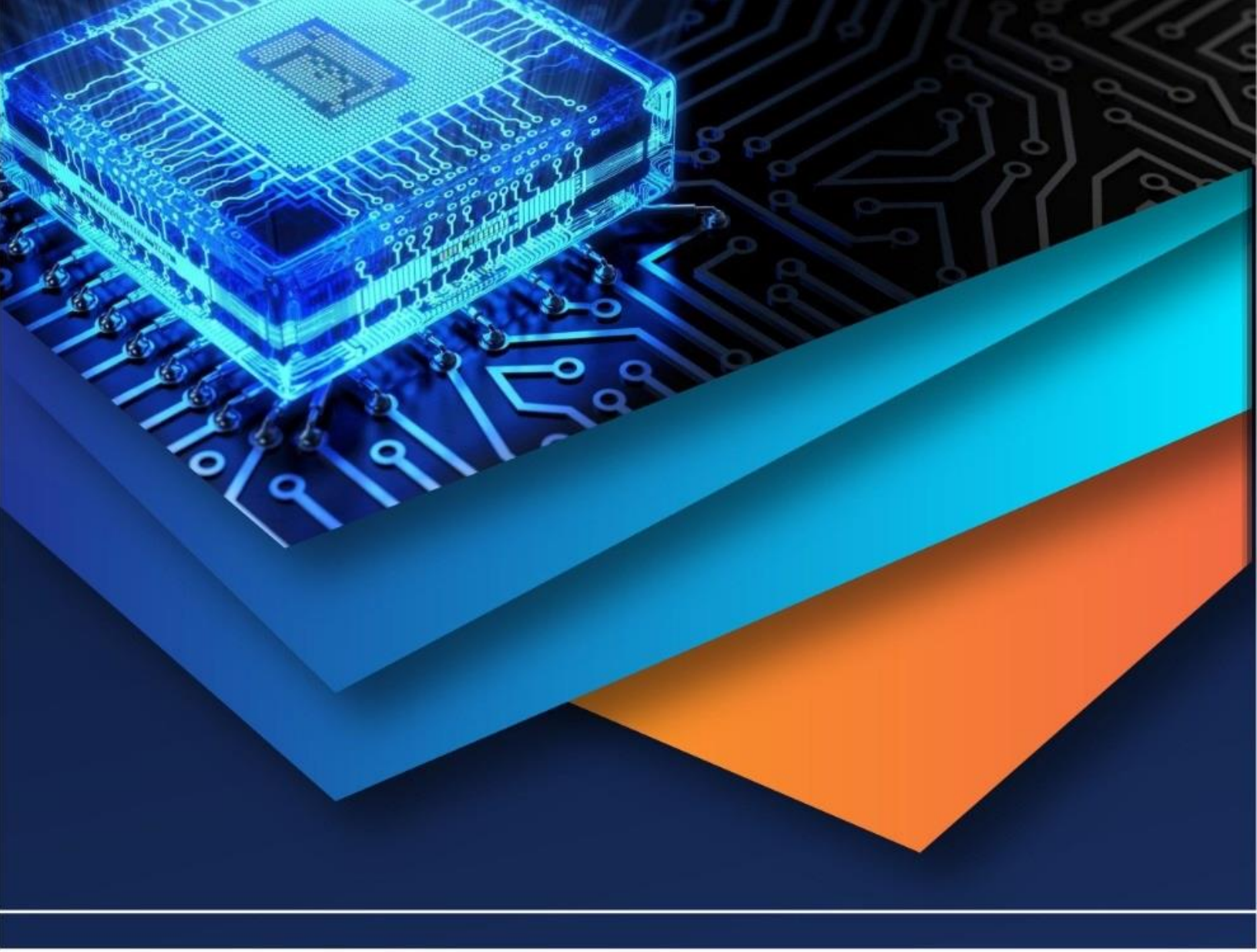
Mutants	Pods/ plant	Pod length (cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	61.74±61.74	5.9±5.9	5.82±5.82	24.12±24.12	13.02±13.02
Early dwarf	42.63±42.63	5.01±5.01	5.61±5.61	24.93±24.93	8.45±8.45
Early semi dwarf	39.48±39.48	5.04±5.04	5.86±5.86	24.18±24.18	8.30±8.3
Late	65.69±65.69	5.92±5.92	5.93±5.93	25.86±25.86	14.11±14.11
High yielding	69.56±69.56	6.01±6.01	6.72±6.72	26.36±26.36	15.01±15.01
SEM±	6.03	0.57	0.61	2.51	1.29
F-value	10.47	1.56	0.99	0.32	12.28
P-value	0.01	0.26	0.46	0.86	0.01
LSD0.05	13.15	--	--	--	2.81

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.

Table: 3e Multilocation trails for stability of reproductive characters in M_6 generation of horsegram mutants
Place- Pimpalwadi, Tal- Kankavali, Dist - Sindhudurg (MS)

Mutants	Pods/ plant	Pod length(cm)	Seeds/ pod	1000 seed weight (g)	Seed yield/ plant (g)
Control	74.33±10.41	6.02±0.84	6.37±0.89	25.35±3.55	14.03±1.96
Early dwarf	51.29±4.10	5.30±0.42	6.09±0.49	26.05±1.28	8.65±0.69
Early semi dwarf	53.80±5.92	5.41±0.60	6.32±0.70	26.14±2.88	8.31±0.91
Late	81.07±10.54	6.12±0.80	7.01±0.91	26.32±3.42	14.93±1.94
High yielding	83.17±11.64	6.11±0.86	6.95±0.97	26.71±3.74	16.02±2.24
SEM±	7.36	0.59	0.66	2.54	1.36
F-value	8.47	0.93	0.76	6.40	14.21
P-value	0.01	0.48	0.57	0.01	0.01
LSD0.05	16.04	--	--	5.54	2.96

Data are means of three replicates ± standard deviation. Significant difference due to treatments was assessed by Fisher's LSD as a post-hoc test.



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