



Research Article

“Genetic Variability and Heritability Analysis in Local Landraces of Sesame (*Sesamum Indicum* L.) in Summer Season Under Foothill Condition of Nagaland”

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Abstract

In the present research endeavor examining twelve native sesame genotypes in Nagaland's foothills during the summer, a Randomized block design with three replications was employed to investigate eleven characteristics. Variations were observed among genotypes across all attributes, with the Yisemyong genotype yielding the most seeds per plant and Medziphema Local – 1 yielding the least. The study indicated that environmental influence was relatively low compared to genetic factors. Traits such as seed yield per plant, number of seeds per capsule, number of capsules per plant, plant height, stem height from base to first branch and oil content exhibited high heritability accompanied, presenting opportunities for enhancing sesame yield.

Keywords: Sesame, genetic variability, PCV, GCV, heritability, genetic advance.

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INTRODUCTION

Sesamum indicum L., commonly known as Benne, is a valuable oilseed plant found in the Tubiflorae order and Pedaliaceae family, as noted by Nayar (1984). It is a diploid plant with 26 chromosomes and likely originated from Asia or East Africa. Sesame goes by different names in various languages and cultures. In English, it's referred to as both "Gingelly" and

"Sesame." In Ayurveda, you'll hear it called "Tila" and "Snehphala," while in Unani medicine, it's known as "Til" and "Kunjad." Among the Ao Naga, it's known as "Etsüng." The Khasi people refer to it as "Nei-iong." Various sesame varieties are available, with creamy white sesame being the most traded. These seeds are small, measuring around 3–4 mm in length, and are rich in unsaturated fatty acids, making sesame a prized

oilseed crop. Sesame is the ninth most significant oilseed crop globally, ranking fifth in India. In India, Gujarat is the leading contributor to sesame production, accounting for approximately 22.3% of the total output. While there are multiple types of sesame seeds, cultivated sesame hails from India, wild sesame is native to sub-Saharan Africa. Sesame is highly nutritious, and its oil contains the antioxidant sesamol, providing resistance to oxidative rancidity (Ashri, 1989). Sesame seeds are often called "seeds of immortality" due to their potent antioxidants. They are rich in oil (50%), protein (23%), and carbohydrates (15%). The presence of lignans in sesame oil gives it a long shelf life. Sesame is used as a substitute for ghee in lower-quality foods. White sesame is used in baking, while black sesame is for medicinal purposes. In India, about 78% of sesame is used for oil production, and sesame oil finds application in various industries like salads, cosmetics, and pesticides. Sesame oil also has therapeutic benefits, such as being diuretic, antiviral, antibacterial, and antifungal. It's known for its skin benefits and its role in maintaining youthful skin and preventing baby rashes. Variations in sesame oil content are influenced by environmental and genotypic factors, with black sesame containing less oil than white or brown sesame. Sesame is grown in India during the *kharif*, summer, and semi-*rabi* seasons. However, *kharif* is the primary season for sesame cultivation, but it often yields low due to poor management and low-yield cultivars. Adequate temperatures and consistent rainfall are crucial for maximizing sesame yield. Water accumulation during flowering or pod development can reduce yield. Sesame is versatile and can be consumed raw, roasted, or dried. Harvesting is typically done when leaves turn yellow, and pods become yellowish-green. Threshing involves beating the well-dried plants with sticks. Sesame has various genotypes, often cultivated by farmers. It's susceptible to drought and flooding, impacting yields. Sesame's genetic diversity makes it crucial for plant breeders. In Nagaland, local sesame cultivars are grown in both *Kharif* and summer seasons. This research intends to analyze how well they perform genetically in the summer season, with a primary emphasis on evaluating the genetic differences among the various genotypes.

MATERIALS AND METHODS

The present field experiment was carried out at the experimental farm of the Department of Agronomy, Nagaland University, School of Agricultural Sciences, Medziphema Campus, Nagaland during the *zaid* season 2022. The location has an altitude of 305 meters above mean sea level and was situated at geographical coordinates of 25°45'43"N latitude and 93°53'04"E longitude. The conducted experiment comprised 12 sesame genotypes that were sourced from local and nearby areas. The genotypes included in the studies are namely Nempo Karjung, Nempo Thepo, Nempo Soksu, Bahaubheti Local, Nempo Charap collected from Assam and Yaongyimsen, Phesama, Chuchuyimlang, Yisemyong, Medziphema Local-1, Medziphema Local-2, Changki collected from Nagaland. 11 genotypes were of Black seed coat color and 1 genotype of white seed coat color. This study used a Randomized Block Design with three replications and gathered data on eleven characteristics from five randomly selected plants in each plot. The eleven characteristics consisted of the following: days to 50

per cent flowering, days to 80 per cent maturity, plant height, number of capsules per plant, internodal length, stem height from base to first branch, seed yield per plant, 1000 seed weight, capsule length, number of seeds per capsule and oil content. The gathered data on the eleven traits of twelve sesame genotypes underwent statistical analysis. The statistical techniques employed encompassed analysis of variance, calculation of average genotype performance, determination of genotypic and phenotypic coefficients of variation, estimation of broad-sense heritability, assessment of genetic advancement expressed as a percentage of the mean.

RESULTS AND DISCUSSION

Mean performances of the sesame genotypes

The analysis of variance (ANOVA) conducted on the twelve sesame genotypes for each of the studied characteristics is summarized in Table 1. It is noteworthy that there is a significant level of variation among all twelve genotypes, suggesting a substantial degree of genetic diversity within the materials utilized in the experiment. All the 11 traits were found to be significant at 5% level of significance.

In the current study, when examining the average seed yield per plant among the twelve local sesame genotypes, it was found that the genotype "Yisemyong" from Mokokchung district of Nagaland exhibited the highest yield at 19.41 g. The second-highest yield was observed in the "Yaongyimsen" genotype (17.69 g), also from Mokokchung district, followed by "Bahaubheti Local" (15.62 g) obtained from Diphu, Assam. On the other hand, the lowest yield was attributed to "Medziphema Local-1" (4.72 g), followed by "Phesama" (5.65 g), both of which were sourced from Nagaland. Genotype "Yisemyong" had the highest total yield at 4.108 kg, while "Medziphema Local-1" had the lowest at 514 g. It's worth noting that adverse weather conditions, including heavy rainfall at maturity, caused some lodging in the crop, and certain genotypes such as "Medziphema Local-1," "Phesama," "Nempo charap," and "chuchuyimlang" displayed significant pod shattering, impacting their yields. Overall, sesame plants performed best under favorable climatic conditions characterized by moderate rainfall and moderate to high temperatures throughout their growth cycle in the foothill region of Nagaland.

Genetic Variability

All of the quantitative characteristics examined in this research exhibited significant variations among the genotypes under investigation, highlighting the substantial genetic diversity within them and making them promising candidates for future breeding projects. As per the classification proposed by Deshmukh *et al.* (1986), traits were considered to have low genetic and phenotypic coefficient of variation (GCV and PCV) if they were below 10 percent, moderate if they ranged from 10 to 20 percent, and high if they exceeded 20 percent. The values are presented in table 3. In this context, the trait seed yield per plant displayed the highest GCV (38.242) and PCV (39.427) values, while days to 80 per cent maturity had the lowest GCV (5.920) and PCV (6.168). Notably, traits such as seed yield per plant and number of capsules per plant exhibited high GCV and PCV values, aligning with previous research by Bharathi *et al.* (2014), Bamorotiya *et al.* (2016), Saxena and Bisen (2016),

Singh *et al.* (2018), Saravanan *et al.* (2020), Sutong and Shah (2021), and Nisha *et al.* (2022).

Traits like internodal length (13.010) (16.576), oil content ((16.726) (16.768), and stem height from the base to the first branch (16.756) (20.551) displayed moderate GCV and PCV values respectively. Conversely, capsule length (8.196) (9.028), days to 50 percent flowering (9.743) (9.960), plant height (7.684) (7.751), and days to 80 percent maturity (5.920) (6.168) had low GCV and PCV values. Similar results were reported by Hika *et al.* (2015) for days to 50 percent flowering, days to 80 percent maturity, and plant height. Number of seeds per capsule and 1000 seed weight showed moderate PCV and low GCV, consistent with findings by Gangadhara *et al.* (2012) and Umamaheswari *et al.* (2019). Across all traits, PCV slightly exceeded GCV in this study, suggesting that environmental factors contributed to the overall variation.

Heritability and genetic advance as per cent of mean

This study employed a scale to categorize heritability and genetic advance as per cent of mean. Heritability was considered low if below 30%, moderate between 30% and 60%, and high above 60%. For GAM, low was less than 10%, moderate was between 10% and 20%, and high was over 20%. The values are presented in Table 3. All the studied traits showed high heritability, aligning with Kehie *et al.* (2020) and Sutong and Shah (2021), except for capsule length. This high heritability suggests that phenotypic selection is effective in achieving desired traits, with minimal environmental influence. Certain traits, such as oil content, days to 50% flowering, internodal length, stem height, seed yield, plant height, seeds per capsule, and number of capsules per plant, demonstrated high genetic advance as a percent of mean. Traits like days to 80% maturity, capsule length, and 1000 seed weight had moderate genetic advance. These findings were consistent with Sutong and Shah (2021) and Lalpantluangi and Shah (2018) for days to 80% maturity, Iqbal *et al.* (2016) for 1000 seed weight, and Kadvani *et al.* (2020) for capsule length. Traits with both high heritability and genetic advance indicate additive gene action, making them suitable for phenotypic selection. High heritability coupled with high genetic advance, as seen in oil content, was

also reported by Jadhav and Mohrir (2012). High heritability paired with high genetic advance for days to 50% flowering matched the findings of Parameshwarappa *et al.* (2009) and Vanishree *et al.* (2013). Similar results were noted for high heritability and high genetic advance in seeds per capsule, as reported by Vanishree *et al.* (2013) and Bindu *et al.* (2014) for traits like oil content, plant height, seed yield, and number of capsules per plant. Traits with high heritability and moderate genetic advance, such as capsule length, 1000 seed weight, and days to 80% flowering, suggest a combination of additive and non-additive gene action. Selecting traits with both high heritability and genetic advance is crucial. Therefore, traits like plant height, days to 50% flowering, oil content, seed yield, seeds per capsule, internodal length, number of capsules per plant, and stem height should be prioritized for creating selection indices in the development of high-yielding sesame varieties. Traits like seed yield per plant and number of capsules per plant, with high GCV, high heritability, and high genetic advance, hold significant potential for genetic improvement in sesame crops.

CONCLUSIONS

There was a sizable degree of variation from the ANOVA for all the traits under study. It was observed that all the traits under study evinced a slightly higher PCV than the GCV which clearly indicates that environmental variance was present and played a role in the overall variance. Certain traits viz., plant height, days to 50% flowering, oil content, seed yield per plant, internodal length, seeds per capsule, number of capsules per plant and stem height from base to first branch delineated high heritability coupled with high genetic advance as per cent of mean which evinced that priority be given to these traits for generation of accurate selection indices for the creation of high yielding sesame varieties. The genotype Yisemyong outperformed all the other genotypes in terms of yield as well as oil content, was not affected by crop lodging and did not exhibit pod shattering characteristics. Therefore, it can be said that the Yisemyong genotype suits under the climatic conditions of Medziphema area and hence it can be suggested for further cultivation and breeding purposes.



Figure: seed plates and Internodal

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Figure: oil content extraction

Source	DF	Mean of sum of square										
		Days to 50% flowering	Days to 80% Maturity	Plant height	Internodal length (cm)	Stem height from base to first branch (cm)	Number of capsules per plant	Capsule length (cm)	Seeds per capsule	1000 seed weight	Oil content	Seed yield per plant (g)
Replications	2	1.333	15.75	4.127	33.765	33.415	601.340	0.0170	177.330	0.288	0.782	2.841
Genotypes	11	82.030*	85.886*	365.485*	6.610*	313.125*	1829.525*	0.114*	147.174*	0.161*	69.520*	61.199*
Error	22	3.545	6.75	6.3086	2.538	104.953	417.395	0.020	45.928	0.060	0.350	3.623

Table 1. Analysis of variance of 11 characters of twelve genotypes

**Significant at 1% level of significance. *Significant at 5% level of significance

Table 2. Mean analysis of the twelve genotypes of sesame for 11 characters

	Days to 50% flowering	Days to 80% Maturity	Plant height (cm)	Internodal length (cm)	Stem height from base to first branch (cm)	Number of capsules per plant	Capsule length (cm)	Seeds per capsule	1000 seed weight (g)	Oil content (%)	Seed yield per plant (g)
1 Nempo Karjung	48.3333	83.3333	144.2533	8.4467	48.4733	64.6000	2.0667	56.4000	2.2267	23.4	11.5233
2 Nempo Thopo	49.3333	82.6667	153.0200	10.0000	42.0667	91.1333	2.2667	59.8667	2.0867	25.5333	10.59
3 Nempo Soksu	52.6667	85.0000	135.4267	8.7000	41.8867	77.2000	2.2400	64.0000	1.7667	33.6333	14.2967
4 Bahaubheti Local	52.6667	86.6667	143.5400	10.4667	54.4500	86.8000	2.2400	64.1333	2.1133	27.7	15.6167
5 Nempo Charap	54.3333	91.6667	149.6467	10.3533	65.2600	62.2667	2.0600	57.6000	1.9867	36.1667	9.77
6 Yaongyimsen	48.3333	85.6667	145.5933	7.8800	61.9400	96.6667	1.9467	67.6333	2.1067	28.7	17.6867
7 Phesama	55.6667	91.3333	123.3133	7.7333	52.0200	49.0667	1.9667	51.5333	2.1733	21.4	5.65
8 Chuchuyimlang	57.0000	90.0000	134.5000	8.7733	42.3000	62.7333	2.6667	55.8333	1.6333	27.6667	8.39
9 Yisemyong	44.6667	78.6667	161.4800	11.6800	66.1867	116.9333	2.1600	70.3333	2.0267	37.4	19.4133
10 Medzhiphema Local 1	58.0000	93.3333	125.5200	9.0933	42.9733	40.5333	2.2333	50.0000	2.5467	27.9	4.7233
11 Medzhiphema Local 2	62.3333	94.0000	144.6733	6.1533	43.2167	40.8000	2.0400	50.1000	1.9133	26.4667	9.8067
12 Changki	46.6667	78.6667	147.9133	8.1767	35.7867	43.2000	2.0333	51.4667	2.1667	28.5333	10
Mean	52.5000	86.7500	142.4067	8.9547	49.7133	69.3278	2.1600	58.2417	2.0622	28.7083	11.4556

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C.v.	3.5865	2.9949	1.7638	17.7917	20.6075	29.4691	6.6580	11.6361	11.9182	2.0628	16.6173
F ratio	23.1368	12.7239	57.9342	2.6042	2.9835	4.3832	5.5162	3.2044	2.6664	198.2443	16.8886
F Prob.	0.0000	0.0000	0.0000	0.0269	0.0140	0.0016	0.0003	0.0097	0.0242	0	0
S.E.	1.0871	1.5000	1.4501	0.9198	5.9148	11.7954	0.0830	3.9127	0.1419	0.3419	1.099
C.D. 5%	3.1884	4.3993	4.2531	2.6978	17.3474	34.5946	0.2435	11.4756	0.4162	1.0027	3.2234
C.D. 1%	4.3336	5.9795	5.7807	3.6667	23.5781	47.0201	0.3310	15.5973	0.5657	1.3629	4.3811

Table 3. Genetic Parameters of yield and its related traits in sesame

Characters	Grand mean	Range		variance			co-efficient of variation			heritability (h ² bs)	Genetic advance	Genetic advance as percent of mean
		Min.	Max.	σ^2_g	σ^2_p	σ^2_e	GCV	PCV	ECV			
Days to 50% flowering	52.50	44.67	62.33	26.162	27.343	1.182	9.743	9.960	3.587	95.7	13.208	25.158
Days to 80% maturity	86.75	78.66	94.00	26.379	28.629	2.250	5.920	6.168	2.995	92.1	13.015	15.003
Plant height (cm)	142.40	123.31	161.48	119.726	121.829	2.103	7.684	7.751	1.764	98.3	28.636	20.109
Internodal length (cm)	8.95	6.15	11.68	1.357	2.203	0.846	13.010	16.576	17.792	61.6	2.414	26.957
Stem height from base to first branch (cm)	49.71	35.78	66.18	69.391	104.375	34.985	16.756	20.551	20.608	66.5	17.931	36.069
Number of capsules per plant	69.32	40.53	116.93	470.710	609.842	139.132	31.295	35.621	29.469	77.2	50.321	72.584
Capsule length (cm)	2.16	1.94	2.66	0.031	0.038	0.007	8.169	9.028	6.658	81.9	0.421	19.514
Seeds per capsules	58.24	50.00	70.33	33.749	49.058	15.309	9.975	12.026	11.636	68.8	12.721	21.841
1000 seed weight (g)	2.06	1.63	2.54	0.034	0.054	0.02	8.883	11.236	11.918	62.5	0.382	18.539
Oil content (%)	28.7	21.4	37.4	23.057	23.174	0.117	16.726	16.768	2.063	99.5	12.645	44.045
Seed yield per plant (g)	11.45	4.72	19.41	19.192	20.4	1.208	38.242	39.427	16.617	94.1	11.218	97.925

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