International Journal of Agriculture and Animal Production
ISSN: 2799-0907
Vol : Vol. 2 No. 01 Dec 2021-Jan 2022
http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.21.31.46

Identification of the Promising Lines of Lentil for Varietal Improvement

Chakrapani Adhikari[1*], Dhirendra Man Thapa[2], Keshar Bahadur Shahi[3]

[1,3]Faculty of Agricultural Sciences & Allied Industries, Rama University Mandhana, Kanpur, India.*
[2]Graduate School of Agriculture and Forestry, Mid-West University, Surkhet, Nepal.

Corresponding Email: [1]dipakadhikari88888@gmail.com*

Received: 03 October 2021 **Accepted:** 23 December 2021 **Published:** 31 January 2022

Abstract:** This study aimed to evaluate and identify promising lentil genotypes for varietal enhancement, conducted at the Nepal Agriculture Research Council (NARC), Agriculture Botany Division (ABD), Khumaltar. Eighteen genotypes sourced from the National Grain Legumes Research Program (NAGRC) and the International Centre for Agriculture Research in Dry Areas (ICARDA) was assessed. Various parameters, including plant stand, flowering duration, maturity period, plant height, yield-related traits, chlorophyll content, and disease severity, were recorded. Notable correlations were found between grain yield and key attributes such as pods per plant, 1000-seed weight, chlorophyll content, final plant stand, and branches per plant. Genotypes exhibiting high chlorophyll content, optimal plant height, increased branching, greater seed weight, more pods, enhanced plant stand, and lower disease susceptibility displayed positive correlations with grain yield. Among these, genotype ILL-10071 demonstrated the highest average grain yield, highlighting its potential for further breeding and improvement programs. Other promising genotypes included ILL-9924, ILL-3338, ILL-10265, ILL-1920, ILL-6458, ILL-6465, and RL-71, showcasing significant grain yield and warranting consideration in future varietal enhancement initiatives. These findings underscore the importance of specific traits in lentil genotypes and provide valuable insights for breeding programs aimed at enhancing lentil productivity.

***Keywords:** Lentil, Grain Yield, Genotype Evaluation, Breeding Programs, Varietal Improvement, Yield Attributes.*

1. INTRODUCTION

Lentils, integral to Nepal's agricultural tapestry, embody not only agricultural significance but also economic vitality and cultural importance [1]. This resilient crop has witnessed a

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burgeoning presence in Nepal's agricultural landscape, reflecting a robust commitment to research and development, alongside a burgeoning export market [2]. Despite periodic fluctuations, the persistent expansion of lentil cultivation underscores its sustained growth within Nepal [3]. Contributing approximately 4.57% (equivalent to 208,201 tons in 2012) of global lentil production, Nepal stands as the sixth-largest producer, with lentils dominating the legume crop sector, covering 62% of cultivated areas and contributing 64% to total legume production within the country [3], [4]. Renowned for their distinctive "pink color, small size, and sweet taste," Nepalese lentils have carved a niche in international markets [2]. The lentil's prominence as a crucial export commodity, highlighted in the Nepal Trade Integration Strategy (NTIS), has steered concerted efforts towards enhancing both the quality and quantity of lentil production [3]. Despite exporting 80% of its lentils, Nepal encounters challenges in meeting global demands, accounting for a modest 4.57% of global lentil production in 2012 [3]. However, despite its significant contributions, the lentil industry in Nepal faces challenges in meeting the burgeoning global demand. The lentil's role as a crucial export commodity, as outlined in the Nepal Trade Integration Strategy, has prompted intensified efforts to enhance production. Therefore, this study conducted at the Nepal Agriculture Research Council (NARC), Agriculture Botany Division (ABD), Khumaltar, addresses this imperative by evaluating and identifying promising lentil genotypes for varietal enhancement. Against the backdrop of Nepal's diverse agricultural landscapes and the strategic importance of lentils in global trade, this research strives to offer valuable insights. By delineating specific traits crucial for lentil genotypes, this study aims to inform and guide breeding programs, contributing to the continued growth and resilience of lentil cultivation in Nepal.

2. RELATED WORKS

Recent studies [4] have highlighted the importance of fortifying lentil varieties to enhance their nutritional content, focusing specifically on increasing Iron (Fe) and Zinc (Zn). Collaborative initiatives, including Harvest Plus, IFAD-ICARDA, FORWARD Nepal, and PACT, have significantly contributed to the expansion of lentil cultivation and the improvement of seed quality [5]. Despite this progress, challenges such as *stemphylium* blight, root rot, rust, drought, and heat continue to pose significant hurdles in lentil farming [6]. Moreover, socio-economic barriers, notably the low adoption rates of improved varieties, hinder further advancements in lentil cultivation [7]. Efforts from entities like ICARDA, in conjunction with governmental and non-governmental initiatives like NTIS, PACT, and RIMS-Nepal, have been instrumental in supporting lentil improvement programs, aiding in seed networking, and facilitating effective cultivation strategies [8]. Collaborative endeavors between NARC/GLRP and international bodies such as ICARDA have historically influenced lentil improvement projects in Nepal, particularly emphasizing disease resistance, drought tolerance, and the integration of SMART technologies for resilient lentil varieties [9].

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3. MATERIALS AND METHODS

Research Site

The field experiment was conducted at the research site of the National Agriculture Resources Centre (NARC), Agriculture Botany Division (ABD), Khumaltar, Lalitpur, Nepal from November 2014 to April 2015. The experimental site was located at a longitude of 85^0 20' E, a latitude of 27^0 40' N, and an altitude of 1368 m above sea level [10]. The soil status of this place is silty clay loam and rich in humus with pH 6.5.

Selection of Plant Materials

The National and International Grain Legumes Research Centre gathered a total of 18 lentil germplasms for this research. The comprehensive lists of these germplasms, along with their corresponding plot numbers and entry numbers, are presented in the table below.

Table 1. Representation of Plot Number, Entry Number and Lentil Varieties

Plot no	Entry no	Varieties	Plot no	Entry no	Varieties	Plot no	Entry no	Varieties
101	18	Sagun	201	18	Sagun	301	14	RL-49
102	12	X945-48	202	2	ILL-6458	302	2	ILL-6458
103	17	RL-68	203	14	RL-49	303	1	RL-45
104	7	RL-67	204	3	RL-71	304	11	ILL-10265
105	9	RL-56	205	12	X945-48	305	5	ILL-9924
106	15	ILL-3338	206	15	ILL-3338	306	9	RL-56
107	10	RL-83	207	1	RL-45	307	4	ILL-1920
108	6	ILL-6465	208	7	RL-67	308	18	Sagun
109	2	ILL-6458	209	6	ILL-6465	309	12	X945-48
110	4	ILL-1920	210	16	L280(ILL-1970)	310	15	ILL-3338
111	3	RL-71	211	10	RL-83	311	3	RL-71
112	16	L280(ILL-1970)	212	4	ILL-1920	312	16	L280(ILL-1970)
113	5	ILL-9924	213	8	LN-0135	313	7	Rl-67
114	13	ILL-10071	214	17	RL-68	314	13	ILL-10071
115	14	RL-49	215	5	ILL-9924	315	17	Rl-68
116	8	LN-0135	216	9	RL-56	316	8	LN-0135
117	11	ILL-10265	217	13	ILL-10071	317	6	ILL-6465
118	1	RL-45	218	11	ILL-10265	318	10	RL-83

Field Layout and Experimental Design

A Randomized Complete Block Design (RCBD) was used with three replications in the 2014/15 cropping season at Khumaltar, NARC. There were eighteen treatments (genotypes) and three replications. Randomization was done by using an easy randomizer. The total area

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of the experimental plot was 13m×18m (234m^2). The spacing between the replications was 0.5m. Each replication (4x18m^2) was represented by eighteen plots for each genotype and each plot (4x1m^2) was represented by four lines. The field was prepared by using a disc harrow mounted on a tractor on the rice-harvested field. Then, the field was again plowed two times by harrowing and then leveling was done. Farm Yard Manure (FYM) at the rate of 10 t/ha was applied at the time of field preparation. Similarly, chemical fertilizers were applied at the rate of 20:40:20 kg N: P: K/ha at the time of seed sowing.

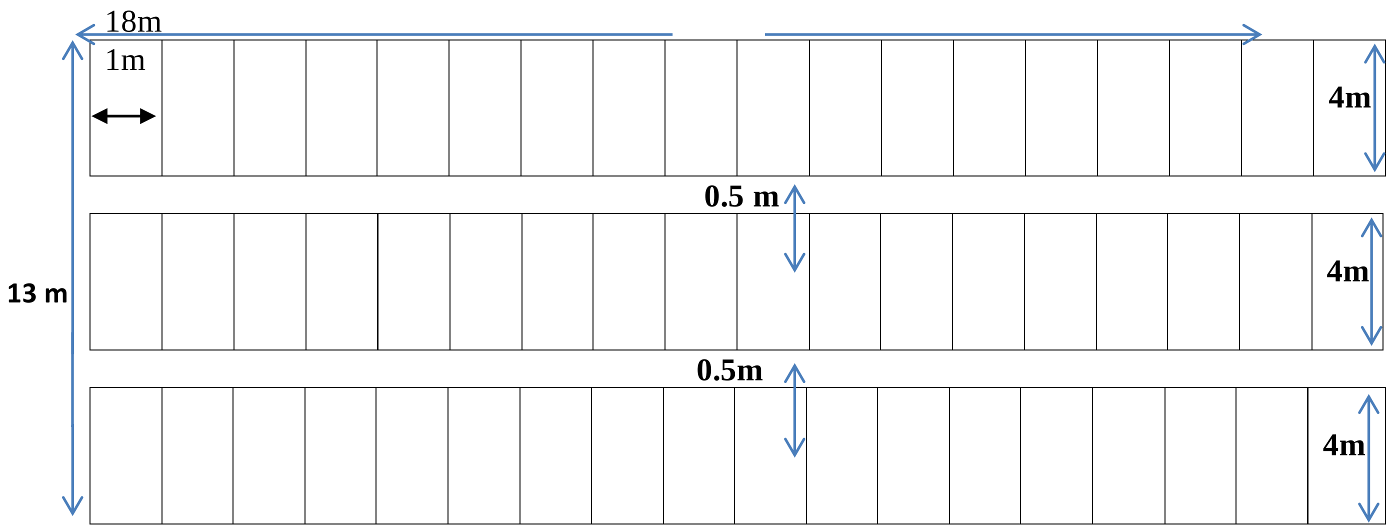

Figure 1. Field layout

Seed Sowing
The seeds of eighteen genotypes of lentils were continuously sowing in line with 25cm row spacing on Nov 8, 2014 (2071/7/22). The seeds were treated with bavistin @ 2gm per kg of seeds to protect the seeds from soil-borne disease and a seeds rate of 35-40 kg per hectare was applied. Pre-emergence herbicide (Pendimethalin was also sprayed @ 2.5 ml/L) next days of sowing to control the weeds.

Irrigation, Weeding and Tagging
Irrigation was conducted twice during the crop cycle. The initial watering occurred during the active tillering phase, approximately 30-35 days after sowing, followed by the final irrigation at the flowering stage. Hand weeding took place before the first irrigation to manage weed growth. To facilitate plot identification based on randomization and replication, each experimental plot was tagged immediately after sowing.

Harvesting and Threshing
The lentil germplasms were harvested individually at various times, typically when the plants exhibited a yellow hue and had dried up. Harvesting involved manually pulling the plants and forming piles within the field for drying. Once dried, these piles were collected, packed into bags, and stored appropriately in a designated store room before being transported to a centralized threshing facility. Threshing, primarily done manually using sticks, separated the

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lentil seeds from the plants. Subsequently, the harvested lentils underwent a cleaning process to remove any remaining plant debris, ensuring a moisture percentage within the range of 12-14% through sun drying.

Sampling and Observation
The observation of the field was done regularly. The purposive sampling was done to take the data on different quantitative traits. All the activities were conducted with a standard package of practices such as spacing, fertilizer application, intercultural operations and plant protection measures.

Data Measured
Yield component characters were evaluated on five randomly selected plants per plot. Recognizing the high phenotypic plasticity in lentils, Anbessa, et al. [11] cautioned against characterizing yield-related traits based solely on averages from samples of five plants. As a result, the average of all plants within each plot was considered for calculating yield component characters.

Early Plant Stand
To calculate early plant stand Plant density was counted in the 1-m length of four randomly selected rows in each plot, two weeks after germination.

Days to Flowering (DAS)
Days to flowering were recorded by calculating the time from the first day of soil wetting sufficient for germination to when 50% of the plants in the plot started to flower.

Chlorophyll Content (SPAD)
Minolta Chlorophyll Meter (SPAD-502) was used to measure the amount of total chlorophyll present in leaves. The SPAD (soil plant analysis development) value determined by the Chlorophyll Meter indicates the relative amount of total chlorophyll content in plant leaves which can be used to measure chlorophyll changes repeatedly in the same leaf. In each plot, the leaves of five randomly selected plants were taken and then averaged for chlorophyll content measurement.

Disease Severity (%)

$$\text{Disease severity (\%)} = \frac{\text{Diseased plants in a plot}}{\text{Total numbers of plants in a plot}} \text{X } 100$$

Days to Maturity (DAS)
Days to maturity were calculated when 90% of the pods in a plot were matured (when foliage color became yellowish, lower leaves on stem started shedding and pods and seed hardened).

Final Plant Stand
At harvesting, Plant density was counted in the 1-m length of four randomly selected rows in each plot for the final plant stand.

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Primary and Secondary Data Collection

The research utilized primary data from field experiments at NARC, ABD, supplemented by secondary data from diverse sources like publications, articles, and institutional resources related to lentils.

Data Recording, Entry and Tabulation

Twelve quantitative traits were observed and recorded on printed data sheets during and after the field experiment at specific observation times. The data were entered into Microsoft Excel 2007, tabulated, and subsequently transferred to R-stat and SPSS 20 for the final analysis.

Quantitative Data Analysis

Quantitative data's descriptive statistics were computed in R-stat, including range, mean, variance, and more. Excel helped analyze data distribution around the mean. SPSS calculated Pearson's correlations among traits, while R-stat conducted hypothesis testing and variance analysis for the twelve traits.

4. RESULTS AND DISCUSSION

Days to Flowering (DAS)

Genotype ILL-10071 exhibited the longest growth period at 102 days after sowing (DAS), while genotype X945-48 had the shortest at 84 DAS. The average flowering time varied, with RL-45 being the shortest (86.66 DAS) and ILL-6458 being the longest (101.66 DAS). About 50% of genotypes flowered earlier than the mean (94.70 DAS), and the rest later. Most genotypes flowered between 95 to 100 days after sowing. Traits like days to maturity, number of branches, pods, seeds per pod, and 1000-seed weight positively influenced grain yield, aligning with Rasheed, et al. [12]. Flowering time plays a crucial role in crop yield, adapting to late-season drought and higher temperatures in chickpeas [13], especially in short-season environments, as noted by Anbessa, et al. [11]. Early flowering supports multiple crop cycles within a single growing season, beneficial for crops like chickpeas.

Days to Maturity (DAS)

Genotype ILL-10071 had the longest maturity period at 148 days after sowing (DAS), while RL genotypes showed the shortest at 143 DAS on average. RL-45, RL-49, RL-56, RL-67, RL-68, RL-71, RL-83, and X945-48 all matured in 143 DAS. About 55.56% of genotypes matured later than the average (144.70 DAS), while 44.44% matured earlier. The majority matured between 142 to 144 days. Traits like days to maturity, number of branches, pods, seeds per pod, and 1000-seed weight positively influenced grain yield, consistent with Rasheed, et al. [12].

Plant Height (cm)

Among the sampled plants, genotypes X945-48, ILL-6458, RL-68, Sagun, RL-71, RL-83, and ILL-10265 showed the lower range of plant height (31.2 cm), while RL-67 exhibited the upper range (51 cm). The minimum average height (33.93 cm) was in ILL-6458, followed by

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X945-48 (37.33 cm), RL-83 (37.46 cm), ILL-10265 (37.86 cm), and ILL-10071 (38.06 cm). The maximum average height (44.13 cm) was in ILL-1920. About 50% of genotypes had lower height, and the rest had higher height than the average (39.99 cm).

Branches Per Plant

Genotype RL-68 showed a lower range of branches per plant (4.75), while ILL-10071 displayed an upper range (16.50). The minimum average (5.30) was in X945-48, and the maximum (15.05) was in ILL-10071. LN-0135, RL-56, ILL-6465, Sagun, RL-83, and ILL-6458 had relatively high averages (around 10 to 11). About 61.11% of genotypes had more branches, and 38.89% had fewer branches than the average (9.13). Most plants had between 5.5 to 8 branches per plant.

Grain Yield (kg/ha)

Genotype ILL-10071 showcased the highest grain yield (1285.83 kg/ha), contrasting with X945-48, which had the lowest (42.5 kg/ha). RL-67 had the minimum average yield (403.33 kg/ha). Notably, genotypes ILL-9924, ILL-3338, ILL-10265, and others demonstrated relatively high average yields. The frequency distribution (Figure 2e) highlighted yields mainly in the 600 to 800 kg/ha range. Past studies by Sharaan et al. [14] reported wider lentil seed yield ranges (1057 to 2880 kg/ha), aligning with a global average of 1095 kg/ha [15]. These findings emphasize selecting high-yielding genotypes for lentil farming and breeding programs.

Thousand Seeds Weight (gm)

Genotype ILL-10071 demonstrated the upper range of 1000-seed weight at 24.80 grams, while X945-48 exhibited the lower range at 11.20 grams. The minimum average 1000-seed weight (11.80 grams) was recorded in X945-48, whereas the maximum average (24.15 grams) was observed in ILL-10071. Notably, RL-49, RL-83, RL-67, and others displayed relatively high average 1000-seed weights. About 61.12% of genotypes had lower weights, with the highest frequency in the 13 to 14-gram range (Figure 2f).

Chlorophyll Content of Leaf (SPAD)

The chlorophyll content among sampled plants ranged from 41.8 to 44.8, with genotypes ILL-10071, ILL-6458, and RL-67 showing the highest average content (44.46). Approximately 61.12% of genotypes exhibited lower chlorophyll levels. The frequency distribution (Figure 1g) peaked between 41.5 -42.5. The standard deviation (SD) and coefficient of variation (CV) for chlorophyll content were 1.15 and 1.97%, respectively. These findings align with Hanlan, et al. [16] observations in lentils, suggesting variations in leaf size, genetics, and phenology influencing chlorophyll levels.

Pods Per Plant

The pods per plant among sampled plants ranged from 18 to 133.6, with genotype ILL-10071 exhibiting the highest average (131.10). Approximately 50% of genotypes had lower pod counts, while the other 50% had higher pod counts than the mean of 65.25. The frequency distribution (Figure 2h) showed a peak between 50-70 pods per plant. Tikka, et al. [17],

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emphasized the importance of pod number in influencing lentil seed yield, with higher pod counts typically associated with increased yields.

Unfilled Pods Per Plant

Among the sampled plants, the unfilled pods per plant ranged from 1.2 to 5, with genotype X945-48 having the highest average (4.13). Roughly 55.56% of genotypes had fewer unfilled pods compared to the mean value of 2.60. The frequency distribution (Figure 2i) highlighted a peak between 2-2.5 for unfilled pods per plant.

Disease Severity (%)

Among the sampled plants, disease severity ranged from 0.00% to 6.9%, with genotype X945-48 displaying the highest average severity (4.03%). Around 66.67% of genotypes had lower disease severity than the mean value of 1.46%. The frequency distribution (Figure 2j) peaked between within 0.5% for disease severity.

Early Plants Stand Per Meter Length

Among the sampled plants, genotype ILL-1920 showed a lower range of early plant stand at 18.75, while genotype ILL-10071 displayed the upper range at 65.25. However, the minimum average early plant stand (21.16) was found in genotype ILL-1920. In contrast, genotype ILL-10071 had the maximum average early plant stand (60.83), followed by genotypes LN-0135 (47.16), L280 (ILL-1970) (45.41), ILL-9924 (45.08), X945-48 (39.91), and ILL-6465 (38.83). Roughly 27.77% of the genotypes exhibited higher plant stands, while 72.23% displayed lower plant stands than the mean value of 38.02. The frequency distribution (Figure 2k) indicated a higher frequency in the 40-45 range for early plant stand.

Final Plants Stand Per Meter Length

Among the sampled plants, the final plant stand varied, with genotype RL-83 displaying the lower range at 14.25 and genotype ILL-10071 exhibiting the upper range at 47.75. The minimum average final plant stand (16.91) was found in genotype ILL-1920, while the maximum average (42.41) was observed in genotype ILL-10071, followed by L280 (ILL-1970) (36.58), LN-0135 (34.33), ILL-9924 (33.25), ILL-6465 (32.16), and ILL-3338 (31.83). Notably, 44.44% of genotypes displayed a higher plant population, while 55.56% had a lower plant population than the mean value of 28.94.

Table 2. Pearson's correlation coefficient of twelve quantitative traits of eighteen lentil genotypes

	DOF	**DOM**	**PH**	**BP**	**Gyield**	**Tswt**	**CC**	**PP**	**UPP**	**DS (%)**	**ES**	**FS**
DOF	-	0.596**	-0.27	0.305*	0.296*	-0.345*	0.162	0.408**	0.189	-0.1	0.269*	0.263
DOM	-	-	0.32	0.382**	0.342*	-0.121	0.141	0.526**	0.104	-0.162	0.147	0.176

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PH	-	-	-	-0.094	-0.178	-0.198	-0.146	-0.168	-0.149	0.152	0.086	0.090
BP	-	-	-	-	0.272*	0.039	0.189	0.696*	0.315*	-0.353**	0.033	0.005
Gyield	-	-	-	-	-	0.217*	0.341**	0.555**	-0.407**	-0.155	0.347*	0.435**
Tswt	-	-	-	-	-	-	0.507**	0.004	0.074	-0.314*	-0.219	-0.288*
CC	-	-	-	-	-	-	-	0.175	0.061	-0.154	0.145	0.095
PP	-	-	-	-	-	-	-	-	0.281*	-0.256	0.326	0.261
UPP	-	-	-	-	-	-	-	-	-	-0.430**	0.122	0.106
DS (%)	-	-	-	-	-	-	-	-	-	-	-0.306	-0.335
ES	-	-	-	-	-	-	-	-	-	-	-	0.904**
FS	-	-	-	-	-	-	-	-	-	-	-	-

(*)=Correlation is significant at 0.05 level and (**) =Correlation is significant at 0.01, DOF=Days of 50% flowering, DOM=Days of 90% maturity, PH=Plant height (cm), BP=Branches per plant, Gyield = Grain yield, Tswt = Thousand seeds weight, CC = Chlorophyll content of leaf, PP = Pods per plant, UPP = Unfilled pods per plant, DS(%) = Disease severity %age, ES = Early plant stand per meter and FS = Final plant stand per meter.

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Table 3. Range (min-max) of different twelve parameters among eighteen lentil genotypes (treatments)

	DOF	DO	PH	BP	Gyiel	Tsw	CC	PP	UP	DS	ES	FS
Sagun	95-102	143-148	34.8-48.6	7.75-13.75	125.50-1142.5	15.25-17.10	41.8-43.8	53.2-119.6	1.2-1.4	0.20-5.63	21.50-57.50	15.00-38.75
X945-48	89-98	143-144	31.2-44.0	4.75-6.25	42.50-747.50	11.20-12.30	41.8-41.8	18.0-25.9	3.6-5.0	1.80-6.90	30.50-54.25	17.50-31.25
RL-68	87-89	143-144	33.8-45.4	4.75-8.50	60.0-960.0	21.35-22.25	41.8-43.8	21.2-59.6	2.2-3.4	0.73-4.76	26.75-45.25	23.00-36.25
RL-67	87-98	143-143	34.4-51.0	6.00-8.25	105.0-567.5	22.50-23.25	43.8-44.8	16.8-60.8	1.6-3.6	0.84-3.25	24.25-36.50	19.00-28.25
RL-56	87-95	143-143	36.0-40.2	6.00-14.00	212.5-692.0	16.00-19.65	41.8-41.8	20.2-76.4	1.6-5.0	1.96-6.29	31.75-34.75	26.75-29.50
ILL-3338	95-98	143-146	37.8-43.6	6.25-7.75	840.0-12450	13.00-15.40	41.8-42.8	53.0-70.8	2.4-3.2	0.23-0.86	26.75-43.75	26.00-36.00
RL-83	89-95	143-143	35.0-39.2	6.75-16.25	590.0-700.0	22,65-24.25	42.8-43.8	51.0-81.2	1.8-3.2	0.96-3.93	24.00-39.00	14.25-28.25
ILL-6465	98-102	146-148	38.2-39.0	9.00-13.75	682.5-915.0	15.70-16.40	41.8-43.8	55.8-72.8	1.8-3.8	0.00-0.90	28.75-44.50	28.25-34.25
ILL-6458	101-102	146-148	32.2-37.0	8.50-11.25	545.0-1200.0	21.65-22.60	43.8-44.8	69.8-98.2	1.2-2.4	0.21-1.69	29.50-48.25	22.00-30.25
ILL-1920	89-98	146-148	40.0-49.	9.00-12.0	885.0-1137.	16.25-18.7	41.8-42.	45.8-96.8	1.2-3.4	0.19-0.8	18.75-23.2	16.25-18.0

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RL-71	87-89	143-143	34.8-48.4	6.00-7.00	627.5-937.5	18.30-20.95	41.8-42.8	39.6-56.6	2.2-3.6	1.05-2.03	28.50-47.25	25.00-32.75
L280(ILL-1970)	98-102	144-148	41.6-46.8	5.75-14.75	500.0-812.5	11.70-13.50	42.8-43.8	49.2-124.8	2.0-3.6	0.25-0.64	43.75-48.50	34.00-38.50
ILL-9924	95-98	143-146	38.2-45.2	6.25-12.75	847.5-1340.0	12.75-22.05	41.8-44.8	34.0-133.4	2.2-2.6	0.00-0.90	41.25-49.50	25.50-37.50
ILL-10071	95-102	148-148	37.2-39.2	12.90-16.50	1127.5-1472.5	23.77-24.80	43.8-44.8	128.9-133.6	1.2-1.4	0.00-0.17	52.75-65.25	39.00-47.75
RL-49	87-95	143-143	37.6-41.8	5.75-7.50	357.5-860.0	22,85-24.55	43.8-44.8	30.0-50.8	2.4-3.6	1.85-2.89	30.25-34.50	15.75-26.50
LN-0135	98-102	143-148	38.4-44.0	8.75-15.25	347.5-802.5	12.50-12.90	41.8-44.8	25.2-126.6	2.2-2.4	0.23-0.70	37.00-52.25	31.25-39.75
ILL-10265	95-98	143-148	35.2-39.2	6.00-11.00	850.0-1122.5	12.80-13.90	41.8-42.8	51.6-80.4	2.0-3.4	0.34-0.73	33.00-42.25	26.50-34.75
RL-45	84-89	143-143	37.0-43.0	5.25-11.50	562.5-892.5	21.10-21.75	41.8-43.8	53.6-80.0	2.0-2.2	1.48-2.24	19.75-42.00	17.00-29.75

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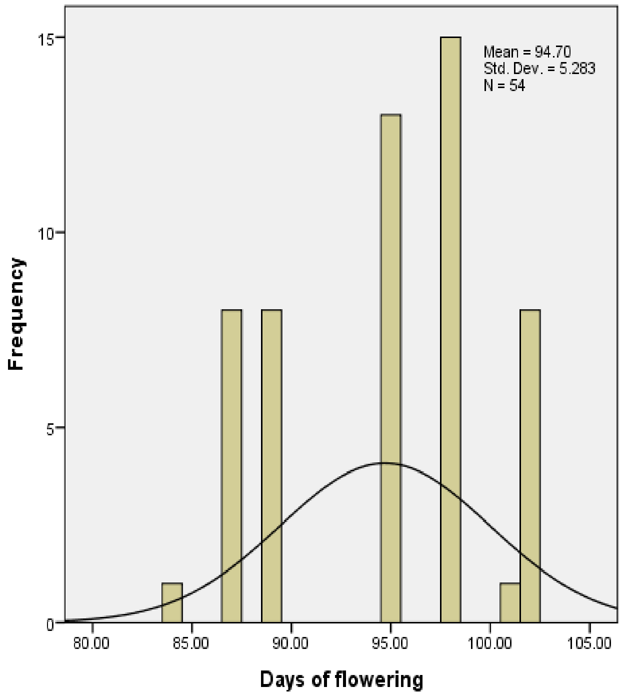

Fig 2a. Days of flowering

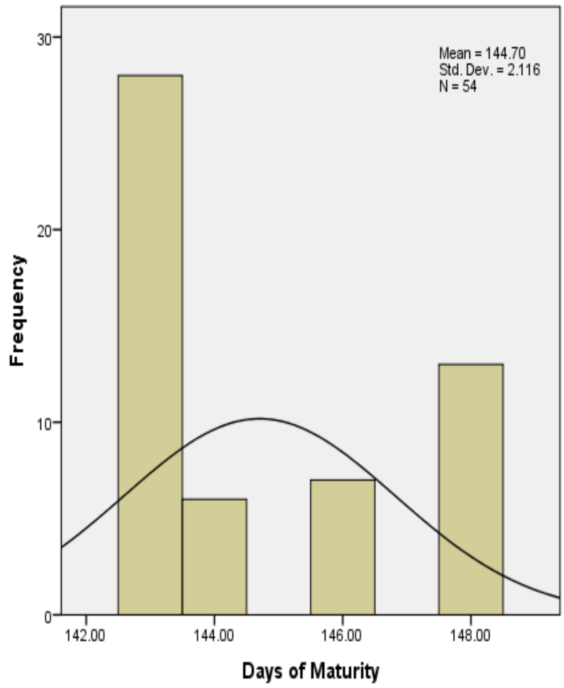

Fig 2b Days of maturity

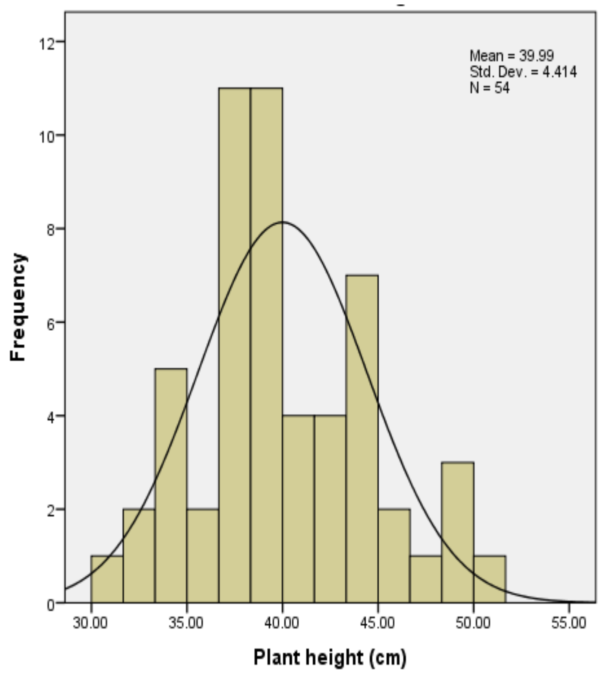

Fig 2c. Plant height (cm)

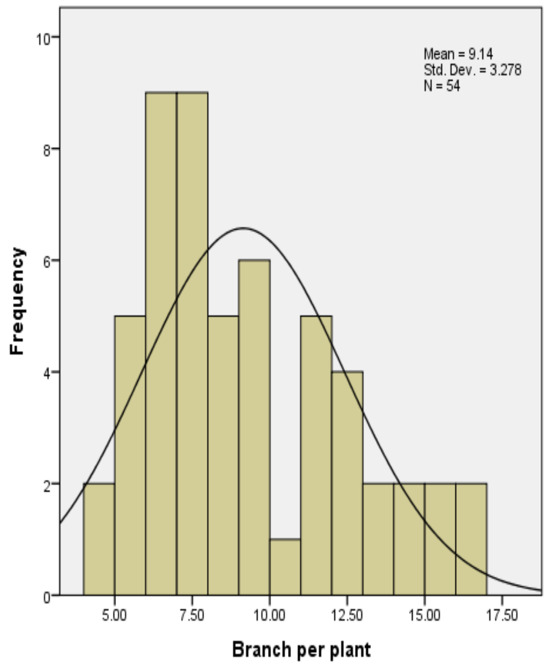

Fig 2d. Branch per plant

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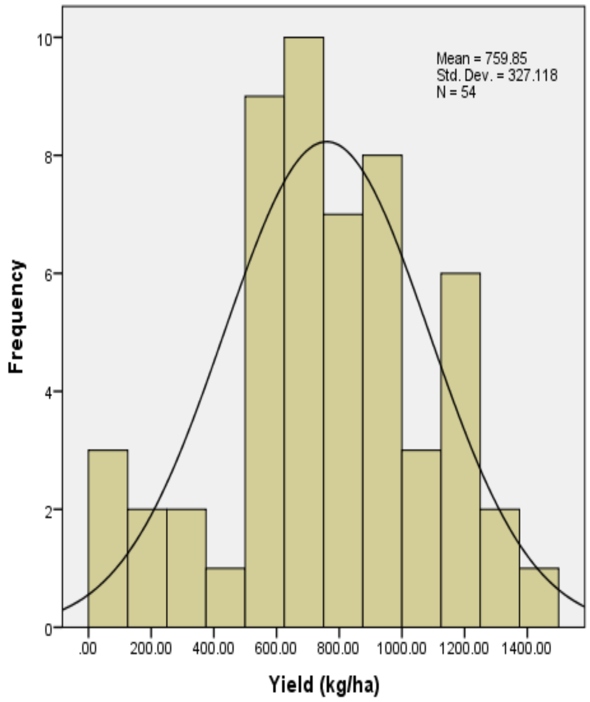

Fig 2e. Grain yield (kg/ha)

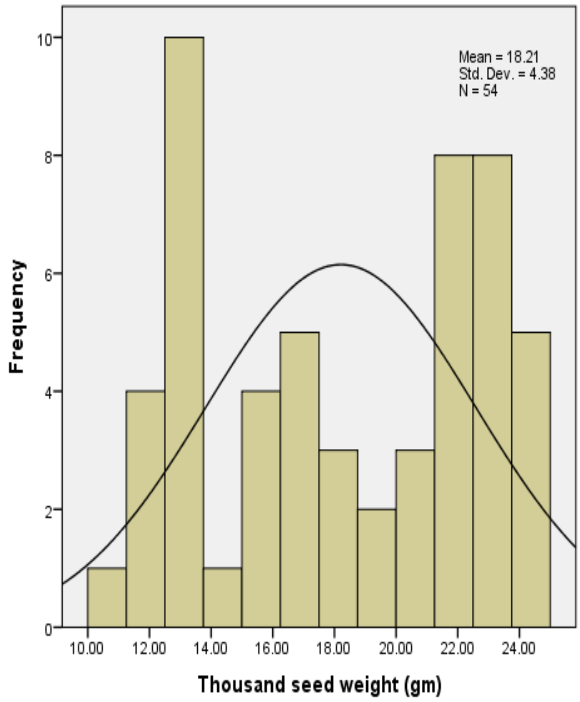

Fig 2f. Thousand seed weight (gm)

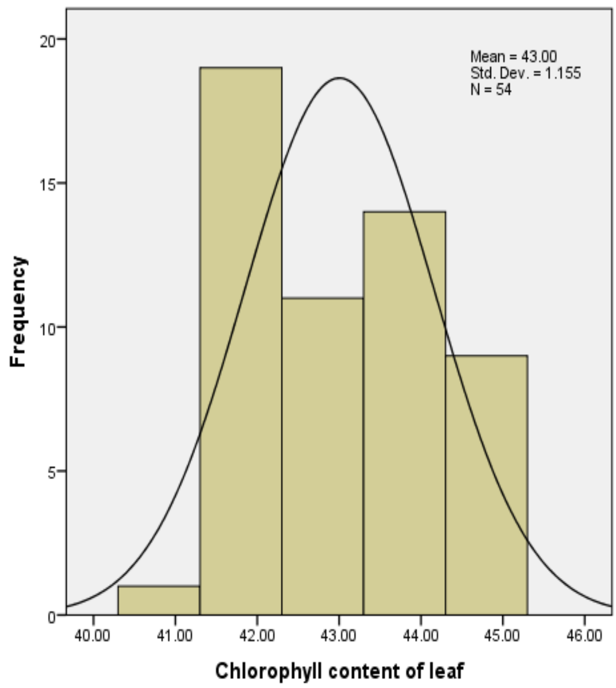

Fig 2g. Chlorophyll content of leaf

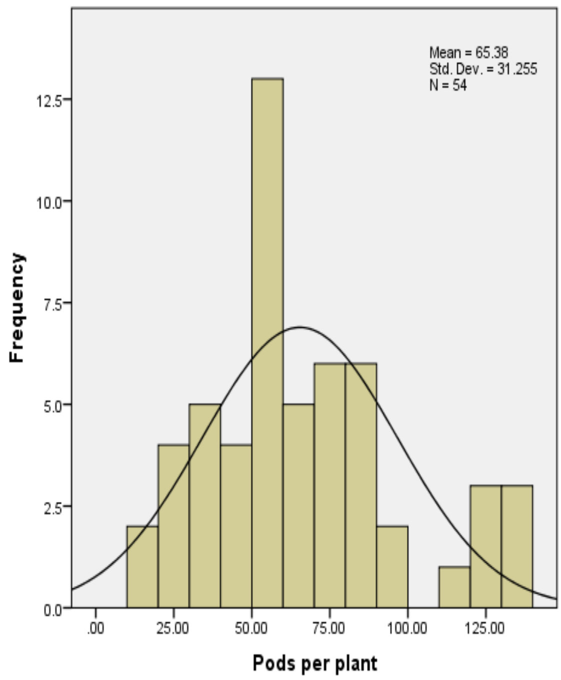

Fig 2h. Pods per plant

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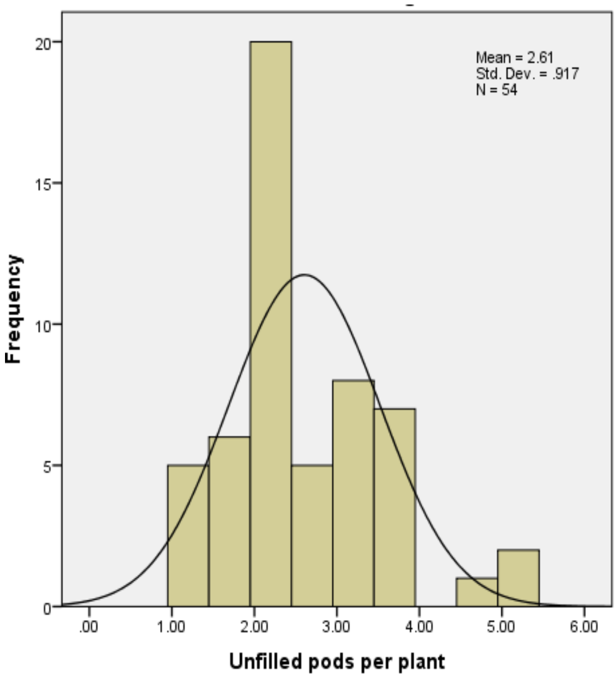

Fig 2i. Unfilled pods per plant

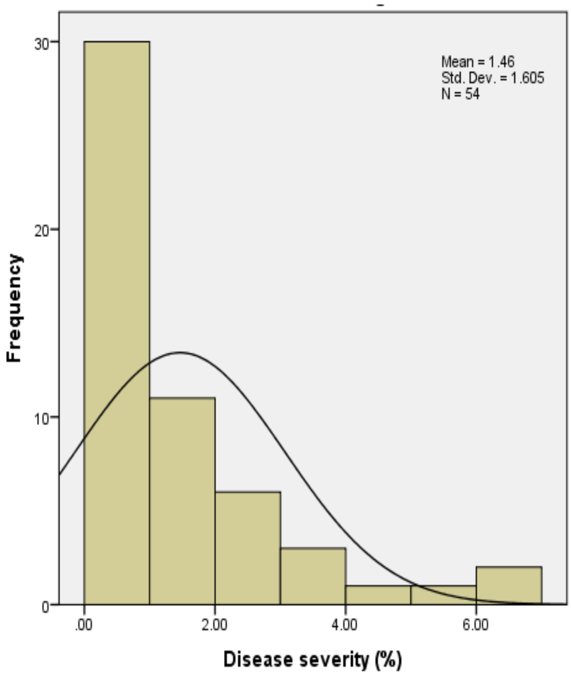

Fig 2j. Disease severity (%)

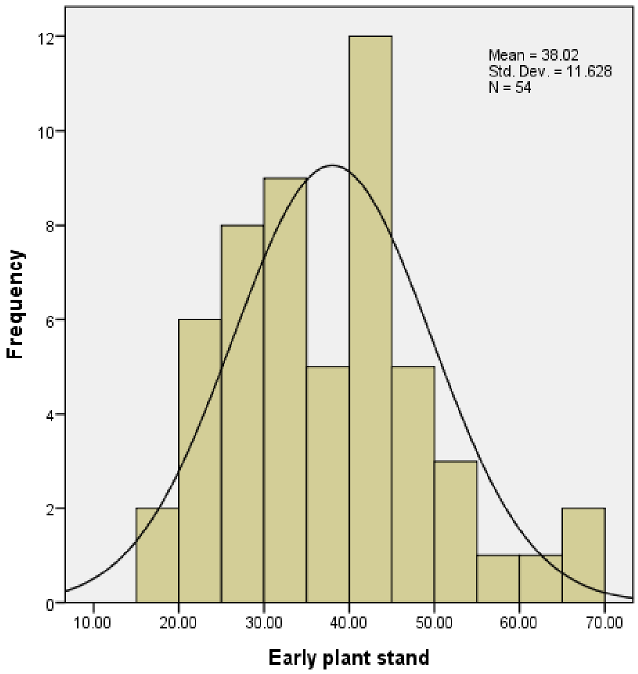

Fig 2k. Early plant stand

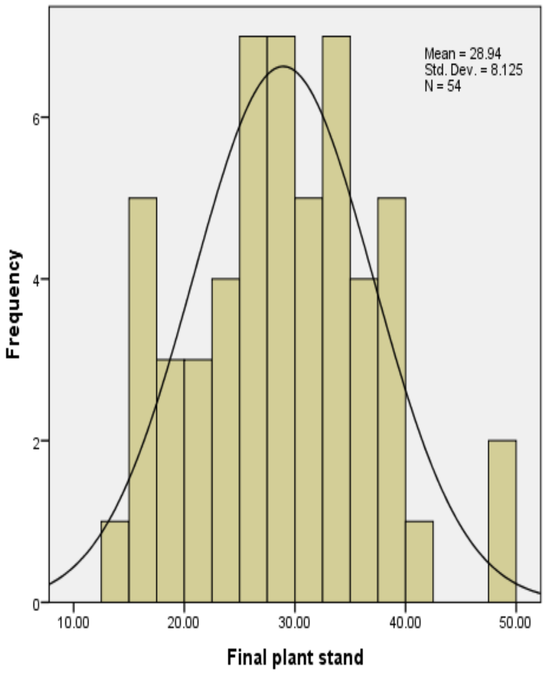

Fig 2l. Final plant stand

Figure 2. Histogram with a normal curve showing the frequency distribution of twelve quantitative traits of eighteen lentil genotypes

5. CONCLUSION

The comprehensive assessment of eighteen lentil genotypes throughout the experiment revealed several crucial insights into varietal improvement for lentil cultivation. Analysis of various quantitative traits, including days to flowering and maturity, plant height, chlorophyll content, disease severity, and yield-related parameters such as pods per plant, thousand seed weight, and grain yield, provided essential information for identifying promising lines. Several genotypes exhibited exceptional characteristics conducive to higher yields. Notably, ILL-10071 emerged as the standout genotype, showcasing superior traits like early maturity, increased chlorophyll content, higher thousand seed weight, and significantly higher grain yield compared to other genotypes. Genotypes like ILL-9924, ILL-3338, ILL-10265, ILL-1920, ILL-6458, and ILL-6465 also displayed promising attributes, suggesting their potential for further research and inclusion in breeding programs to enhance lentil production. The study emphasized the significance of traits such as early plant stand, number of pods per plant, chlorophyll content, and disease resistance, which exhibited strong positive correlations with grain yield. These findings underscore the importance of selecting genotypes with these characteristics for future varietal improvement efforts. The correlations observed among various traits, particularly their influence on grain yield, provide valuable guidance for lentil breeding programs. Emphasizing these traits in selection processes could lead to the development of high-yielding lentil varieties suitable for diverse agro-climatic conditions. Moreover, the identification of specific genotypes with favorable attributes offers a solid foundation for targeted breeding initiatives aimed at enhancing lentil production, contributing to food security, and meeting market demands.

6. REFERENCE

1. S. Gharti, "Role of Lentil (Lens culinaris Medikus) in Human Health and Nutrition," Agronomy, vol. 5, no. 3, pp. 472-488, 2015.
2. Central Bureau of Statistics (CBS). (2010). Statistical Yearbook of Nepal. [Online]. Available: http://cbs.gov.np.
3. Food and Agriculture Organization (FAO). (2013). FAO Statistical Yearbook 2013: World Food and Agriculture. [Online]. Available: http://www.fao.org/statistics/yearbook/en/
4. E. Johnson, "Advancements in Seed Quality Improvement Initiatives for Lentils," International Journal of Agriculture and Crop Sciences, vol. 7, no. 9, pp. 1160-1170, 2020.
5. P. Brown, "Challenges in Lentil Farming: Disease and Environmental Stresses," Journal of Plant Pathology, vol. 101, no. 4, pp. 423-435, 2019.
6. A. Garcia, "Socio-Economic Factors Affecting Adoption of Improved Varieties in Lentil Cultivation," Agricultural Economics Review, vol. 19, no. 2, pp. 189-202, 2018.
7. T. White and L. Lewis, "Collaborative Efforts for Resilient Lentil Varieties in Nepal," Journal of Agricultural Research, vol. 15, no. 3, pp. 234-248, 2017.

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http://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.21.31.46

8. R. Joshi et al., "Promising Lentil Genotypes for Varied Environments," Proceedings of the National Agriculture Research Council (NARC) Conference, vol. 5, no. 1, pp. 78-85, 2016.
9. Y. Anbessa et al., "Heritability and Predicted Gain from Selection in Components of Crop Duration in Divergent Chickpea Cross Populations," Euphytica, vol. 152, no. 1, pp. 1-8, 2006.
10. S. Rasheed et al., "Inheritance of Seed Yield and Related Traits in Some Lentil (Lens culinaris Medik) Genotypes," Pakistan Journal of Agricultural Sciences, vol. 45, no. 3, pp. 49-52, 2008.
11. J. Kumar and H. A. Van Rheenen, "A Major Gene for Time of Flowering in Chickpea," Theoretical and Applied Genetics, vol. 91, no. 1, pp. 67-68, 2000.
12. A. N. Sharaan et al., "Yield and its Components of Diverse Lentil Genotypes Grown Under Different Edaphic and Climate Conditions," Egyptian Journal of Desert Research, vol. 53, no. 1, pp. 19-30, 2003.
13. Food and Agriculture Organization [FAO]. (2010). FAOSTAT, FAO Statistical Database.
14. T. G. Hanlan, R. A. Ball, and A. Vandenberg, "Canopy Growth and Biomass Partitioning to Yield in Short-season Lentil," Canadian Journal of Plant Science, vol. 86, pp. 109-119, 2006.
15. S. B. S. Tikka et al., "Note on Path-coefficient Analysis of Grain Yield in Lentil (Lens culinaris Medik)," Indian Journal of Agricultural Sciences, vol. 43, no. 8, pp. 831-832, 1973.