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Effects of Planting Time on Growth, Yield and Yield Related Traits of Lentil "Lens culinaris Medikus" at Central Ethiopia

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ABSTRACT: Planting time plays an important role in the growth, development, and yield of Lentil genotypes. Lentil (Lens Culinaris Medik) is a multipurpose annual legume crop grown in many environments in Ethiopia. Lentil varieties respond differently to different planting times. The availability of a significant detailed study on physiological progress on twenty lentil genotypes planted during normal (NPD) and late planting days (LPD) is comparatively low. The present study has been carried out considering the above fact. A field experiment was conducted at Dz station and Ak sub-station in 2021and/or 2022 to study the effect of two sowing times on phenology and yield of twenty lentil varieties by using a Randomized Complete Block Design (RCBD) of three replications. At Ak substation, during NPD and LPD the result shows higher biomass and seed yield than the Dz station. Ak sub-station on genotypes R186 biomass yields were 13.3 NPD and 9.7t/ha LPD. On the genotype R186, the biomass was 11.6 NPD and 6.0 t/ha LPD at Dz station. Early 50% flowering and days to maturity genotypes on Beredu exhibited maximum harvesting index at both locations. During LPD reproductive functions are markedly reduced leading to escape reproductive growth, abort, or shatter pod formation, and shortening the flowering period in all genotypes causing decreases in yield. Genetic responses with higher biomass yield and harvest index at Dz and Ak during normal planting days indicate the importance of time of planting that demonstrated the main breeding goal. The adverse effect of delayed planting time can be mitigated by forecasting optimum planting time. The study valuable for the Agricultural sector designed to minimize the gap on adaptation and yield status which were contributing to self-sufficient for stakeholders around central Ethiopia.

Keywords: Genotype, Lentil, Planting, Seasons, Sowing date, Trait

1. Introduction

Lentil is a prehistorically domesticated crop and is one of the legumes consumed for food globally (Mihraa et al, 2016). The central origin of lentil is Central Asia, and a major share of production comes from Asia (FAO, 2022). It is a major winter food legume in Bangladesh based on consumer preference, although grass pea ranks in the first position due to its area coverage and production (DAE, 2020). Low temperatures are essential for lentil vegetative growth, but warm temperatures are required at the

(2n=2x=14) annual legume crop with a genome size of about 4Gbpsp (Arumuganathan, 1991). It is an ancient pulse crop grown for more than eight thousand years. Lentil was originated in the fertile crescent area of Near East and further distributed in the other areas of Europe, the middle east, and Africa (Zohary, 1992; Cokkizgin & Mungez, 2013). Globally, it is the second pulse crop among the legumes (Shahwar et al, 2017). Nepal, India, Turkey, Australia, the United States, Iran, Syria, Ethiopia, Canada, China, are the uppermost lentil-producing county in the world.

Legumes give inconsistent yields as compared to cereals (Hay R., 1995). Average yield over a range of growing occasion and situation is some extent less (Hedley C., & Ambrose M., 1981). When scarcity of land occurs but consumption of crops is intense currently grain legume production is necessary to make them economically attractive like other higher yielding cereals to make seeds important for consumption both humans and animals (Kumar S., et al., 2013). Lentil (*Lens culinaris* Medik.) is one of the most important winter season grain legumes cultivated in South Asia, West Asia, Middle East, Southern Asia, and South America. Globally, it is cultivated in an area of 3.85 million hectares with a production of 3.59 million tons (Bejjga G., 1991). Ethiopia ranks tenth in the world and first in Africa in terms of lentil production (FAO, 2019). Global and Africa productivity of lentils covers an area of about 87,443.29 hectares with an annual production of 1193, 28.893 t and the average estimation of national productivity is being about 1.365t/ha (CSA, 2019).

Planting time is familiar to influence in lentil improvement as well as progress that had impact on ultimate productivity. In Ethiopia, (Bejiga, G., 1984) reported that plant before the main season at the end of June and the following week of July growing productivity. Planting mid-July decrease productivity and the time to physical growth has stopped. Compare with the biological clock of a Lentil plant during rainy season is one of key features that can make suitable condition to innovative district. Change by means of phenology leads to growth increase by 45–60% at South Asia (Siddique et al., 2003). Rising productivity in lentil via reproducing of variety between under-growth and blooming time (Kusmenoglu, I., and Muehlbauer, F.J, 1998). Late-spring blooming frequently important in getting higher pod-filling stage prior to scarcity of rain in the time of final maturity (Silim, et al., 1993). In different circumstances, in the rain conditions forecast decisive point production, various scientific study of cyclical biological events great power and essential (Saxena, M.C., 2009). However, they exhibit poor yield stability (Moot D.J., and McNeil, D.L., 1995) as compared to cereals. Seed yield and harvest index (HI) of grain legumes are unstable, even crops with good vegetative growth sometimes it give poor yields. Climate change and variability causes severe economic damage. The severity of damage caused by these stresses depends on timing and intensity of the stress. Lentil is extremely sensitive to heat stress, especially during the flowering and seed filling stages. Temperature exceeding 32°C can restrict photosynthesis, metabolic pathways, electron flow, and respiration rate, which cause flower abortion, pollen infertility, and reduction in the number of pods in lentil. These changes lead to significant losses in grain yield (Bhandari, K., et al., 2007). Water stress also affects plants at different growth stages, including vegetative (intermittent drought) and reproductive (terminal drought) stages. Terminal drought can suppress nearly all the processes of lentil growth and metabolism, causing heavy yield losses (Sitak, et al., 2017), as it reduces flower production, pod number, and seed number. The other distinct morphological characters of lentils are also large seeded (macrosperma) types which are native to West Asia and North Africa and Southern Europe (FAO, 2022). Lentil plants adapt to various stress tolerance mechanisms to respond to like drought stress.

Understanding mechanisms of drought stress tolerance in plants including curtailed water loss by increased diffusive resistance, enhanced water uptake with prolific and deep root systems and its efficient use, and smaller and succulent leaves to reduce the transpiration loss. Physiological basis of yield difference among the genotype of lentil is essential to quantify a growth component which is utilized in crop improvement. Important physiological attributes can address various constraints of a variety for increasing its productivity.

A probable system for describing production feasibility or variation within planting date which exposing plants to stress in rain at flowering stage. Planting on different sowing day is features of Lentil cultivation that possess and transpire under-examined. Although, very little information is available about the effect of late and normal planting on lentil growth and productivity. For that reason, the objective of the study to determine the impact of two planting date on growth, reproductive function and yield under field condition.

2. Materials and Methods

2.1 Experimental place and Design

Experiment carried out Dz as well as Ak experimental stations during 2021. The soil type of the experimental sites at both locations is classified as Vertisol with clay loam texture. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications. A plot consisting of four rows of 3 m length by 0.8 widths (2.4 m^2) with spacing of 0.2 m between rows, 0.4 m between plots and 1.5 m between blocks was used. A seed rate of 200 seeds was administered to each row. The normal planting date (NPD) and late planting date (LPD) experiments respectively were planted on August 12 and September 23 for Dz; and August 21 and September 24 for Ak substation based on the last ten-year rainfall distribution pattern (2010-2020). Throughout the experimental period, plots were made free of weeds using hand weeding and 20g NPS fertilizer application on each plot. All pertinent field trial management practices were implemented.

Differences among the varieties for measured variables were subjected to analysis of variance (ANOVA) using R software version 4.1.2. Significant means were separated using Tukey at 5% significance level. Variance ratio test for homogeneity of variance was carried out to determine the validity of the individual experiment. Log transformation was used for those traits, which exhibited heterogeneity of variance including yield, number of seed per plant at Dz for NPD and at Ak number of primary branch for LPD. Observations were recorded on days to 50% flowering and days to physiological maturity on whole plant basis. At the time of harvesting, five plants were randomly selected from each plot for recording on yield and associated traits namely plant height (m), number of branches, and number of total pods. After harvesting each plot measures were taken traits of 100-seed weight (kg), biological yield (t/ha) and grain yield (kg).

2.2 Weather Data

The minimum and maximum temperatures during the plant growth period for NPD was 4.12 and 25.36 °C between at Dz station, while for LPD or the stress situation, minimum and maximum temperatures were from 7.66 to 27.36 °C (Figure 1a). Whereas at Dz station accumulated rainfall for NPD was about 409.14 mm between August 2021 and December 2021. Accumulated rainfall LPD between September 2021 and January 2022 was about 237.38 mm.

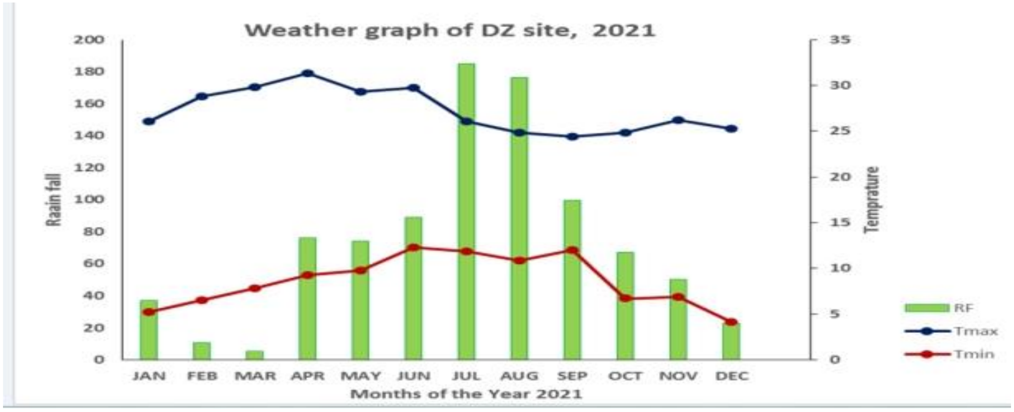

Figure 1a: Temperature and rainfall distribution pattern at Dz station in the year 2021.

Whereas at sub-station (Akaki) accumulated rainfall for NPD was about 651.1mm between August 2021 and December 2021. Minimum and maximum temperatures differed from 2.28 to 24.02 °C. Accumulated rainfall for stress situation between September 2021 and January 2022 was about 683.04mm; minimum and maximum temperature was about 2.84°C and 24.63°C respectively.

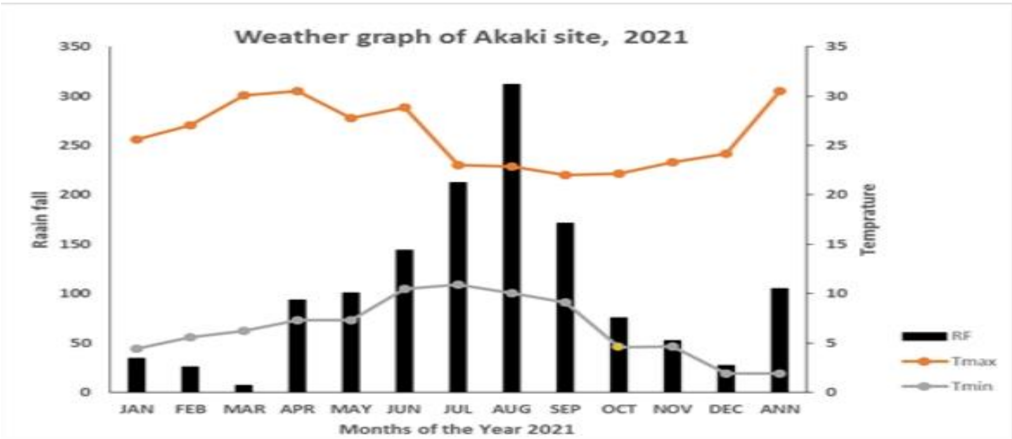

Figure 1b**:** Temperature and rainfall distribution pattern at Akaki sub-station in the year 2021.

3. Results and Discussions

A total of twenty genotypes (Adda, 94-003L, R186, ILL-1760,96006L-984005, Alemtena, Checkol, Alemaya, Dz-2012-Ln-238,Gudo,ILL-2178, X-125-54, 09583227-04, Jiru, Beredu, Challew, Dz2012-Ln0050,ELL-142, Teshale and Derash) were studied to evaluate the most suitable high yielding lentil (*Lens culinary* Medik) genotypes under Late Planting Day (LPD) and Normal Planting Day (NPD) at Debre Zeit station and Akaki substation. The result obtained during the research work summarized as parameter wise detail below.

3.1 Days to 50% Emerge

NPD: the day to 50% emerge among the tested genotype ranged from 7- 12 at Dz station and 9.3 - 11.3 at Ak substation. The minimum day of emerge during NPD on the genotype Beredu at Dz station and 96006L-984005 at Ak substation. LPD: the days to 50% emerge among the tested genotypes ranged from 8 – 16.3 at Dz station and 10 – 13.6 at Ak substation. The minimum day of emerge during LPD on the genotype 94-003L at Dz station and 96006L-984005 at Ak substation (Table 1a).

3.2 Day to 50% flowering

During normal planting Day (NPD): the day to 50% flowering among the tested genotypes ranged from 40-50 at Dz station and 47- 71 at Ak substation. The minimum day of 50 % flowering during the main planting day exhibited by on the genotype Beredu at Dz station and 96006L-984005 at Ak substation. During Late planting Day (LPD): the day to 50% flowering among the tested genotypes ranged from 53.3 - 76 at Dz station and 52-75.6 at Ak substation. The minimum days of flowering during the LPD exhibited by on the genotype Beredu at Dz station and 96006L-984005 at Ak substation (Table 1a).

3.3 Plant height

In the genotype 09583227-04 the highest plant height was observed during the NPD at Dz station it ranged from 0.22 – 0.383 and at Ak substation 0.186 - 0.323 on the genotype adda where the heights' plant height was observed. During LPD the highest plant height were observed on the genotype 09583227-04 at Dz station and on the genotype adda with the highest value of 0.257 at Ak substation (Table 1a).

3.4 Seed Yield (ton/hectare)

The grain yield data revealed that significantly different between genotypes. The maximum yield was recorded from genotypes Dz-2012-Ln-238 up to 2.38 t/ha, followed by genotype R186 2.74t/ha production at Dz station during NPD. At Ak substation the maximum yield recorded on the genotype R186 up to 3.41t/ha. The genotype Chekole was the deprived genotype among all regarding the grain yield having less than 0.03t/ha. LPD: the grain yield data ranged from 0.019 – 0.17 at Dz station, the maximum yield was recorded among the tested genotypes on R186 i.e 0.17t/ha and the minimum yield recorded on the genotype Theshale, Almtena and ELL142 at Dz station. At Ak substation the maximum yield recorded 2.7t/ha among the tested genotypes at R186 and the minimum yield recorded on the genotype Teshale and Checole (Table 1b).

3.5 Harvesting Index (HI)

Harvesting index data reveled that significantly different between the tested genotypes. The highest harvesting index recorded on the genotypes Beredu at Dz station 0.628 and 0.425 at Ak substation during the normal planting day. During late planting day the highest value was recorded on the genotype 96006L-984005 with the value of 0.071 at Dz station and 0.48 on the genotype Beredu at Ak substation (Table 1b). Analyses of variance at Dz station was on the two-planting days showed highly significant ($P < 0.001$) differences among varieties and their interaction for the traits like days to 50% flowering, days to 50% emerge, maturity period, biomass yield ton per hectare, seed yield ton per hectare, and plant height (Table 2a). Analyses of variance on physiological traits at Ak sub-station was on the normal and late planting time showed highly significant ($P < 0.001$) differences among varieties for days to 50% flowering, maturity period, biomass yield, number of seed per plant and plant height (Table 2b). Strong positive correlation ($r = 0.87$) was recorded between the traits of plant height, day to maturity, day to 50% flower, and day to 50% emerge ($r = 0.8$), biomass yield and Seed yield (Fig 2).

Table 2a: Analysis result, source of variation and level of significance at Dz station during 2021.

Character	Sources of variation			
	Variety(df=19)	Pt date(df=1)	V*pt (df=	Error(df=78)
Day to 50% emerge	9.85***	95.82***	6.565***	1.41
Day to 50% flower	120.8***	7836***	29.1***	10.5
Day to maturity	1114***	10272.5***	784***	13
Sy(t/ha)	0.0206***	0.1911***	0.006***	0.0011
Ptht(m)	0.0071***	0.078***	0.00067	0.0012

Note: pt date= planting date; V*pt= variety by planting date; bio (t/ha) = biomass in ton per hectare. SY (t/ha) = seed yield in ton per hectare; Ptht (m) = plant height in meter.

Table 2b: Analysis result source of variation and level of significance at during 2021 at Ak substation.

Character	Sources of variation			
	Variety(df=19)	Pt date(df=1)	V*pt(df=19)	Error(df=)78
Day to 50% emerge	4.412**	45.63***	0.475	1.782
Day to 50% flower	192.4***	725.2***	0.21	10.66
Day to maturity	208.9***	3297***	49	31.8
Sy(t/ha)	16***	652***	16***	4.6
Ptht(m)	0.007***	0.017***	0.003***	0.0006

Note: pt date= planting date; V*pt= variety by planting date; bio (t/ha) = biomass in ton per hectare; SY (t/ha) = seed yield in ton per hectare; Ptht (m) = plant height in meter; SY/pt (kg) = seed yield per plant in kilogram.

Similarly (Talaka, A., et al., 2013) also reported considerable variation in days to 50%germination in concerning lentil genotypes. Significant genetic variability in flowering period of lentil genotypes has also been reported by some earlier scientist like (Bakhsh, A., et al., 1993). Similar studies on plant height of different lentil varieties were also reported by (Yaqoob, M., et al., 2005b) 31st October sown varieties were also significantly taller than 30th November. Singh, D., and Singh, R.P., 2014, reported that early sowing gave optimum plant height and delay in sowing reduced plant height. Lentil yield affected by environmental, agronomic conditions and change in genetic constitutes. As reported by earlier scientists, (Aziz, M. A., 1992). Variability in harvesting index essential contributor in yield and stability growing under normal and late planting date under two locations. Harvesting index was higher scored on main planting time than stress condition. Maximum productivity happens among with large harvesting index afterwards change into critical principle for plant genetic (Pilbean, C.J., 1996).

Table 1a; Mean value of genotypes Harvesting Index and seed yield planting during 2021 at both location.

Genotype	Day to 50% Emerge				Day to 50% flower				Plant height			
	Debre-Zeit		Akaki		Debre-Zeit		Akaki		Debre-Zeit		Akaki	
	NPD	LPD	NPD	LPD	NPD	LPD	NPD	LPD	NPD	LPD	NPD	LPD
Ada	10 bcd	10.67 bcd	9.66 bc	10.3 c	47 bcd	65.3 bcde	54.3 efg	59.3 fgh	0.53 abc	0.317 abc	0.323 a	0.257 a
94-003L	8.3 def	8.0 e	10.33 abc	11.3 abc	45.67 def	58.3 efgh	55 defg	60 efgh	0.29 cdef	0.27 def	0.27 bc	0.207 cde
TR	10.67 abc	8.67 de	11 ab	11.3 abc	50 a	65.3 bcde	62.3 bc	67.3 bcd	0.353 abc	0.323 ab	0.31 ab	0.23 abc
TILL1760	11 abc	11.3 bc	10.7 abc	11.3 abc	50 a	74 a	64.7 b	68 bc	0.353 abc	0.293 abcd	0.217 defg	0.223 abcd
T96	8.3 def	10.67 bcd	9.33 c	10 c	44.3 f	56.3 gh	47 i	52 j	0.296 cdef	0.27 def	0.2 gh	0.187 de
Talt	9.3 cde	12 bc	10.7 abc	11.6 abc	46.67 cde	62.3 defg	58.3 cde	63.3 cdef	0.286 def	0.227 g	0.15 i	0.193 cde
TC	12 a	16.3 a	10.3 abc	11.3 abc	50 a	62.67 defg	60.3 bcd	65.3 bcde	0.220 g	0.186 h	0.15 i	0.133 f
Tal	8.3 def	12 bc	11.3 a	13.3 ab	45.3 def	62.3 defg	53 efgh	58 fghi	0.32 abcdef	0.257 defg	0.257 cd	0.208 cde
Tln238	8 ef	11.3 bc	11 ab	12.3 abc	44 f	57.3 fgh	53 efgh	58 fghi	0.33 abcde	0.253 efg	0.253 cde	0.213 bcde
TG	8 ef	12.67 b	10 abc	10.6 bc	44.67 ef	57.3 fgh	51.3 ghi	56.3 hij	0.363 ab	0.28 cdef	0.247 c-f	0.227 abc
TILL2178	11.67 ab	11 bc	11.3 a	13.3 ab	50 a	71 abc	64 b	69 b	0.323 abcdef	0.287 bcde	0.213 e-h	0.257 a
TX	7.67 ef	12 bc	10.66 abc	11.3 abc	44 f	60.67 defg	52.66 fgh	57.6 ghi	0.323 abcdef	0.273 def	0.263 c	0.183 e
T09	10.67 abc	11.3 bc	11 ab	12 abc	49 ab	76.3 a	70.66 a	75.6 a	0.383 a	0.33 a	0.27 bc	0.26 a
TJ	12 a	12.67 b	10.66 abc	12.3 abc	44.67 ef	64.3 cdef	56.66 defg	61.6 efgh	0.326 abcdef	0.277 def	0.207 fgh	0.247 ab
TB	7 f	12 bc	10 abc	11.3 abc	40 g	53.3 h	48 hi	53 ij	0.306 bcdef	0.247 fg	0.26 c	0.223 abcd
Tca	11.67 ab	11.67 bc	9.66 bc	10.6 bc	50 a	72 ab	57 cdef	62 defg	0.327 abcdef	0.247 fg	0.177 ghi	0.21 bcde

TDz	8^{ef}	12^{bc}	9.66^{bc}	10.3^{c}	44.67^{ef}	56^{gh}	53.66^{efg}	58.6^{fgh}	0.346^{abcd}	0.26^{defg}	0.27^{bc}	0.217^{bcde}
TE	10.67^{abc}	10.67^{bcd}	11.33^{a}	13.6^{a}	48.67^{abc}	63^{defg}	55.66^{defg}	60.6^{efgh}	0.263^{fg}	0.247^{fg}	0.25^{cde}	0.197^{cde}
Tte	11.3^{ab}	12.3^{b}	9.66^{bc}	11^{abc}	49^{ab}	65.67^{bcd}	56^{defg}	61^{efgh}	0.28^{efg}	0.243^{fg}	0.173^{hi}	0.183^{e}
Tde	9.33^{cde}	11.3^{bc}	11^{ab}	13.3^{ab}	44.33^{f}	56.3^{gh}	55^{defg}	60^{efgh}	0.33^{abcde}	0.267^{def}	0.27^{bc}	0.203^{cde}
Mean	**9.7**	**11.5**	**10.46**	**11.7**	**46.8**	**63**	**56.4**	**61.35**	**0.318**	**0.267**	**0.236**	**0.213**
LSD	**1.9**	**2.04**	**1.59**	**2.68**	**2.27**	**7.21**	**5.52**	**5.39**	**0.065**	**0.039**	**0.0416**	**3.71**
CV	**11.9**	**10.74**	**9.19**	**13.9**	**2.94**	**6.9**	**5.92**	**5.32**	**12.62**	**8.98**	**10.65**	**10.51**

Note: Tada, T94-003L, TR186, TILL-1760, T96, Talt, TC, Tal, Tln238, TG, TILL2178, TX, T09, TJ, TB, Tca, TDz, TE, Tte, and Tde which means genotype adda, 94-003L, R186, ILL-1760,96006L-984005, Alemtena, Checkol, Alemaya, Dz-2012-Ln-238,Gudo,ILL-2178, X-125-54, 09583227-04, Jiru, Beredu, Challew, Dz2012-Ln0050,ELL-142, Teshale and Derash respectively

Table 1b; ~~**Mean value of genotypes Harvesting Index and seed yield planting during 2021 at both location.**~~

Genotype	Harvesting Index (HI)				SY(t/ha)			
	Debre-Zeit		Akaki		Debre-Zeit		Akaki	
	NPD	LPD	NPD	LPD	NPD	LPD	NPD	LPD
Tada	0.105^{hij}	0.037^{cdef}	0.242^{cdefg}	0.256^{bcd}	$0.95(0.1156)^{fgh}$	$0.47(0.07)^{cdefg}$	1.73^{de}	$1.4(0.38)^{b}$
T94-003L	0.251^{bcde}	0.037^{bcdef}	0.296^{abcdef}	0.387^{ab}	$1.73(0.198)^{cd}$	$0.52(0.059)^{cdefg}$	2.37^{bc}	$1.4(0.378)^{b}$
TR	0.242^{bcdef}	0.066^{ab}	0.206^{cdefg}	0.303^{bc}	$2.74(0.281)^{ab}$	$1.0(0.17)^{a}$	3.41^{a}	$2.7(0.566)^{a}$
TILL1760	0.143^{efghi}	0.0353^{cdef}	0.338^{abcd}	0.093^{bcde}	$1.67(0.191)^{cd}$	$0.67(0.062)^{cdefg}$	1.353^{ef}	$4(0.325)^{bc}$
T96	0.385^{b}	0.071^{a}	0.311^{abcde}	0.297^{bc}	$1.66(0.195)^{cd}$	$0.92(0.13)^{ab}$	0.87^{g}	$0.7(0.234)^{cde}$
Talt	0.339^{bc}	0.025^{ef}	0.346^{abc}	0.110^{ef}	$0.84(0.104)^{def}$	$0.11 (0.019)^{g}$	0.34^{hij}	$0.3(0.0924)^{fg}$
TC	0.0^{j}	0.0216^{f}	0.134^{g}	0.030^{f}	$0.03(0.0)^{j}$	$0.03 (0.06)^{c-g}$	0.03^{j}	$0(0.0129)^{g}$
Tal	0.251^{bcde}	0.0516^{abcd}	0.166^{efg}	0.229^{bcde}	$1.43(0.169)^{def}$	$0.47 (0.07)^{cdefg}$	0.94^{fg}	$0.6(0.202)^{def}$
Tln238	0.252^{bcde}	0.064^{ab}	0.268^{bcdefg}	0.332^{ab}	$1.51(0.174)^{de}$	$0.62 (0.098)^{bcd}$	2.12^{cd}	$1.2(0.342)^{bc}$
TG	0.163^{defghi}	0.0307^{def}	0.222^{cdefg}	0.242^{bcde}	$0.74(0.098)^{gh}$	$0.26 (0.04)^{efg}$	0.72^{gh}	$0.4(0.152)^{efg}$
TILL2178	0.224^{cdefgh}	0.0446^{bcdef}	0.331^{abcd}	0.234^{def}	$1.08(0.135)^{efg}$	$0.64 (0.091)^{bcde}$	1.79^{de}	$1.4(0.376)^{b}$
TX	0.283^{bcd}	0.0476^{abcde}	0.206^{cdefg}	0.382^{ab}	$1.85(0.205)^{cd}$	$0.5 (0.087)^{bcdef}$	2.03^{cd}	$1.2(0.343)^{bc}$
T09	0.089^{ij}	0.024^{ef}	0.186^{defg}	0.135^{def}	$0.73(0.091)^{gh}$	$0.22 (0.041)^{efg}$	0.89^{fg}	$0.7(0.228)^{cde}$
TJ	0.189^{defghi}	0.0273^{def}	0.322^{abcde}	0.168^{cde}	$0.58(0.08)^{hi}$	$0.23 (0.037)^{fg}$	0.54^{ghi}	$0.5(0.176)^{efg}$
TB	0.628^{a}	0.036^{cdef}	0.425^{a}	0.480^{a}	$2.12(0.23)^{bc}$	$0.27 (0.041)^{efg}$	2.05^{cd}	$1.3(0.356)^{b}$
Tca	0.113^{ghi}	0.0266^{ef}	0.417^{ab}	0.115^{def}	$0.49(0.068)^{hi}$	$0.32 (0.05)^{defg}$	0.699^{gh}	$0.6(0.193)^{def}$
TDz	0.282^{bcd}	0.063^{ab}	0.331^{abcd}	0.296^{bc}	$2.83(0.287)^{a}$	$0.76(0.1)^{bcd}$	2.82^{b}	$1.1(0.315)^{bcd}$

TE	0.087^{ij}	0.0293^{def}	0.153^{fg}	0.134^{def}	0.16(0.0276)^{ij}	0.12(0.019)^{g}	0.21^{ij}	0.1(0.046)^{fg}
Tte	0.122^{fghi}	0.023^{ef}	0.187^{defg}	0.268^{bcd}	0.23(0.032)^{ij}	0.11(0.023)^{g}	0.33^{hij}	0.3(0.104)^{efg}
Tde	0.231^{cdefg}	0.059^{abc}	0.307^{abcdef}	0.312^{bc}	2.69(0.275)^{ab}	0.86(0.105)^{bc}	2.71^{b}	1.42(0.355)^{b}
Mean	**29.19192**	**30.38**	**29.63**	**28.51901**	**1.3(0.148)**	**0.068**	**1.399**	**1.1(0.259)**
LSD	**0.219**	**0.043**	**0.26**	**0.25**	**0.055**	**0.053**	**0.475**	**0.105**
CV	**0.12**	**0.03**	**0.177**	**0.131**	**22.75**	**27**	**20.52**	**24.63**

Note: Tada, T94-003L, TR186, TILL-1760, T96, Talt, TC, Tal, Tln238, TG, TILL2178, TX, T09, TJ, TB, Tca, TDz, TE, Tte, and Tde which means genotype adda, 94-003L, R186, ILL-1760,96006L-984005, Alemtena, Checkol, Alemaya, Dz-2012-Ln-238, Gudo, ILL-2178, X-125-54, 09583227-04, Jiru, Beredu, Challew, Dz2012-Ln0050, ELL-142, Teshale and Derash respectively.

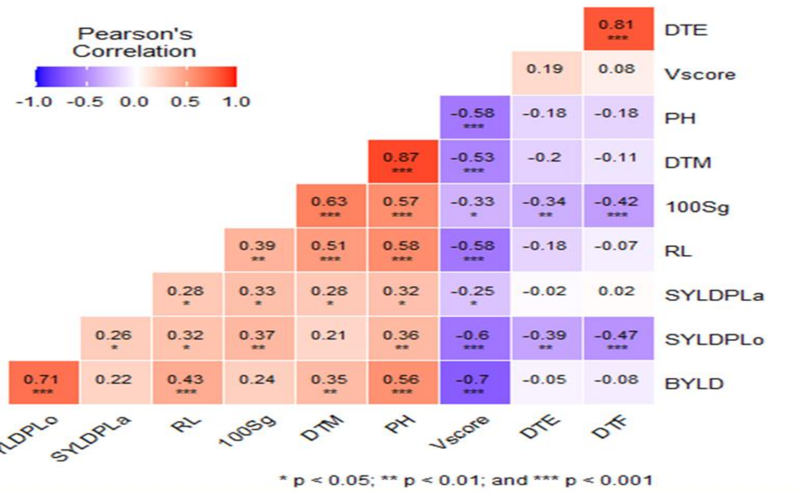

Figure 2: Pairwise Association analysis between Agronomic Traits on main planting time at Debre-Zeit station.

Rainy and arid era (Roys, S., et al., 2013), applying fertilizer, planting time, shelter/cover, watering (Hernandez, L.O., 1986; Verghis, T.I.1996) and lodging may all be reasons for HI variability. Under late planting conditions, growing season especially from flowering to maturity shortened due to forced maturity of crop, consequently, lentil yield was reduced in late planted crop as compared to normal planted crop has been described by (Anwar, M.R., et al., 1999). Genotypes mature and flower early on normal planting time than late planting day, but it has not yet different on emerge. Generally, genotype Chekol was the variety that took a long period to flower and mature, while highest yielding variety 'Beradu' is among the varieties that flower and mature early. Genotype were observed to flower and mature early at main planting time and record higher days to flower and mature on late planting day. These indicating that traits were interdependent, and thus one trait can be improved through indirect selection for the other trait. Additional situation, during rainy season anticipated in the time of analytical level of plant development, a various scientific study of cyclical biological events could be essential (McKenzie, B.A., et al., 1985).

4. Conclusion and Recommendations

Late sown plants showed that increase in days to emerge, days to flower and days to maturity while decrease yield, plant height and harvesting index as compared to normal time of planting. High temperature in combination with minimum rain during the reproductive stage in the late planting was extremely detrimental for all twenty lentil genotypes with only minor differences among them. Normal planting day studies, where the plant subjected to high temperature during reproductive growth also validated the detrimental effect of low rainfall distribution on studied trait, like Akaki substations. Different planting day limit the growth and production potential of lentil (*Lens culinaris* Medikus), particularly during reproductive growth and seed filling. Our results showed that the different lines responded differently to different sowing dates and location. Planting time one of the most severe environmental factors that affect, most critical phase in the plant life cycle and productivity of lentil. Overall, findings revealed that normal and late planting day substantially affects all traits. Sowing during main planting season (NPT) revealed that generate greater percentage of productivity and increases lentil production at central Ethiopia.

Declarations

The manuscript has not been submitted in any other journal or conference.

Conflicts of Interest

There are no conflicts to declare.

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