

## Evaluation of Pre-Released Bold Seeded Lentil Varieties on Different Weather Factors for Growth and Yield Potentiality in the New Alluvial Zone of West Bengal, India

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### ABSTRACT

A study was conducted for two consecutive years (2012-2013 and 2013-2014) to assess the performances of sixteen pre-released and two standard varieties of bold seeded lentil on different weather factors, for their growth and productivity potential. Growing Degree Days (GDD) requirement for vegetative stage differ from 715.8 to 1077.3 day degree Celsius, in first year and 667.7 to 698.9 day degree Celsius in second year. For completion of reproductive stage GDD requirement was 513.5 to 1016.8 day degree Celsius in first year and 644.6 to 1056.9 day degree Celsius in second year. Heliothermal Unit (HTU) requirement for vegetative stage differ from 5343.6 to 7358.7 day degree Celsius hour in first year and 4737.8 to 4777.8 day degree Celsius hour in second year. HTU requirement also differ in two years. In first year HTU requirement was 4076.5 to 7300.0 day degree Celsius hour and 5987.9 to 11803.7 day degree Celsius hour in second year. Significant differences were observed in plant height, dry matter accumulation, yield and yield attributes of the crop. The dry matter accumulation was better in the second year. The seed yield was maximum in PL-129 in both the year. The second year yield was lower than the first year, as it was exposed to higher temperature during the reproductive phase of the crop. The maximum productivity of lentil would be archived when the maximum and minimum temperature during 100% flowering ranged from 24.6 to 28.6 and 10.1 to 10.9°C in two years respectively.

### Keywords

Pre-released variety, Lentil, GDD, HTU, Yield attributes.

### Article Info

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### Introduction

Lentil is a cool season food legume growing in the span of November to March in West Bengal and rank next only after chick pea in India. The New Alluvial zone of West Bengal is marked by short winter and mild temperature. Because of the temperature sensitivity of this crop, selection of proper varieties of lentil is important for better productivity of this crop. Bhattacharyya

(2009) assessed several lentil genotypes for their yield variability. It is observed that the duration from sowing to flowering is an important parameter for yield variability in pulses. He and Rajaram (1993) observed that the plant height is more sensitive to the temperature in winter crop. However the impact of temperature and Bright sunshine hour (BSSH) on lentil varieties has not been

evaluated elaborately in the New Alluvial zone of West Bengal. The present experiment has been framed to address this vacuum. It was reported that the local environment important for growth and productivity (Erskin *et al.*, 1989). The major constrains to seed production in most of the cases is higher temperature during flowering and seed growth. Summerfield *et al.*, (1985) reported that higher temperature during reproductive phase accelerated progress towards reproductive maturity and reduce seed yield. Hundal and Kaur (2007) observed that an increase in temperature up to 1°C reduces the yield of wheat.

## Materials and Methods

The experiment was carried out during winter (November-March) seasons of 2012-13 and 2013-14 at the District Seed Farm, AB block, Kalyani, BCKV, (Latitude 22°58' N and Longitude 88°32' E), West Bengal, India. The study site is flat and is located at an altitude of 9.75 m above mean sea level (AMSL). The experimental site falls under tropical humid climate, experiences three distinct seasons (summer, rainy and winter). The mean annual temperature falls below 20°C in November and continued up to early part of February. The maximum and minimum relative humidity (RH) ranged from 85-100% and 22-96% respectively. The soil contents 51% sand, 18.7% silt and 30.4% clay and is classified as sandy loam. The pH of the soil is 7.35 having total nitrogen, available phosphorus, available potassium and organic carbon as 298 kg ha<sup>-1</sup>, 30.2 kg/ha<sup>-1</sup>, 195 kg/ha<sup>-1</sup> and 0.48% respectively. The experiment was conducted in the winter season of 2012-2013 and 2013-2014 in a RBD (Randomised block design) with sixteen pre released bold seeded varieties and two check varieties (K-75, DPL-62) for their growth and productivity. Each treatment was allotted in a plot of 4×2.0 m with two replications. Each treatment

received 20, 40 and 40 kg N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O per ha through urea, SSP (Single super phosphate) and MOP (Muriate of potash). The description of pre released lentil varieties is given in table 1. The duration of the different phenophases, plant height, dry matter accumulation, yield attributes and yield were estimated. The growing degree days (GDD) per day was calculated in accordance with the following formula:

$$\text{GDD} = \{[\text{Maximum temperature (}^{\circ}\text{C)} + \text{Minimum temperature (}^{\circ}\text{C)}] / 2\} - \text{Base temperature}$$

Heliothermal unit (day degree Celsius hour) was measured by following formula:

$$\text{HTU} = \text{GDD of a phenophase} \times \text{Average Bright Sunshine hours of that respective phenophase}$$

## Results and Discussion

### Impact of weather on growth

#### Impact of temperature

GDD, which is a temperature based index has been computed and its impact on plant height and dry matter accumulation has been assessed. Plant height was significantly affected by the GDD. Plant height increased exponentially with the increment of GDD in all the varieties/genotypes (Fig: 1). R<sup>2</sup> value ranged from 0.676 (in case of genotype RVL 48) to 0.9036 (in case of genotype LL 1210) indicating the impact of GDD on plant height (Fig 1). GDD requirement for different varieties/genotypes differs (Table 2). The total GDD requirement was maximum in VL 521 in both the years. However, year to year variations were evident because of the temperature variation as well as the difference in the duration in two different years. GDD requirement for the vegetative phase in 1<sup>st</sup>

year ranged from 715.8 day°C to 1077.3 day °C where as in the 2<sup>nd</sup> year, it ranged from 667.7 to 698.9 day°C. During reproductive phase the GDD requirement for the 1<sup>st</sup> and 2<sup>nd</sup> year ranged from 513.5 to 1016°C GDD and 644.6 to 1056.9°C GDD respectively (Table 3). In the 2<sup>nd</sup> year the GDD requirement was higher than the 1<sup>st</sup> year, due to the variation in temperature and duration of the crop.

The dry matter accumulation was found to be the exponential function of GDD although the relationship was insignificant in most of the cases (Fig. 2).

### **Impact of temperature and BSSH (Bright Sunshine Hour)**

In both the year wide variation in the HTU requirement for the different phenophases was observed for different varieties/genotypes (Table 4). In both the years the genotype VL 521 required maximum HTU from sowing to maturity. The HTU requirement ranged from 9840.5 to 13503.6 day degree Celsius hour in the 2<sup>nd</sup> year while in the 1<sup>st</sup> year it ranged from 9887.1 to 14714.2 day degree Celsius hour. In both the year wide variation in the HTU requirement for the onset of different phenophases was observed for different varieties/genotypes (Table 5). HTU requirement for the vegetative and reproductive phases in lentil varied remarkably in two different experimental years. This was due to the variation in the day temperature as well as the sun shine hour in different phenophases. More over the difference in the duration also caused this sort of variation. In the 1<sup>st</sup> year, the HTU requirement in vegetative phase was higher than the reproductive phase except in case of the genotypes VL 521 and VL 48. Whereas in the 2<sup>nd</sup> year, the HTU requirement for the reproductive phase was higher than the vegetative phase in most of the cases. This contradictory result appeared due to the variation in the duration of reproductive phase

as well as the ambient temperature during the reproductive phase.

The HTU requirement significantly affected the plant height in all the varieties/genotypes. The relationship was found to be exponential. In other words, the plant height in lentil is an exponential function of HTU (Fig. 3). The effect of HTU on dry matter accumulation in different varieties/genotypes was found to be insignificant (Fig. 4).

### **Summarizing the results the following conclusion may be drawn**

The GDD requirements for the onset of different phenophases differed in different varieties/genotypes. Even the same variety/genotype recorded different GDD requirement in a particular phenophase in two different experimental years. This was due to the variation in the duration and temperature condition in two different years.

Alam *et al.*, (2004) also reported that the GDD requirement varied in different years because of the difference in the atmospheric temperature and the duration of the crop.

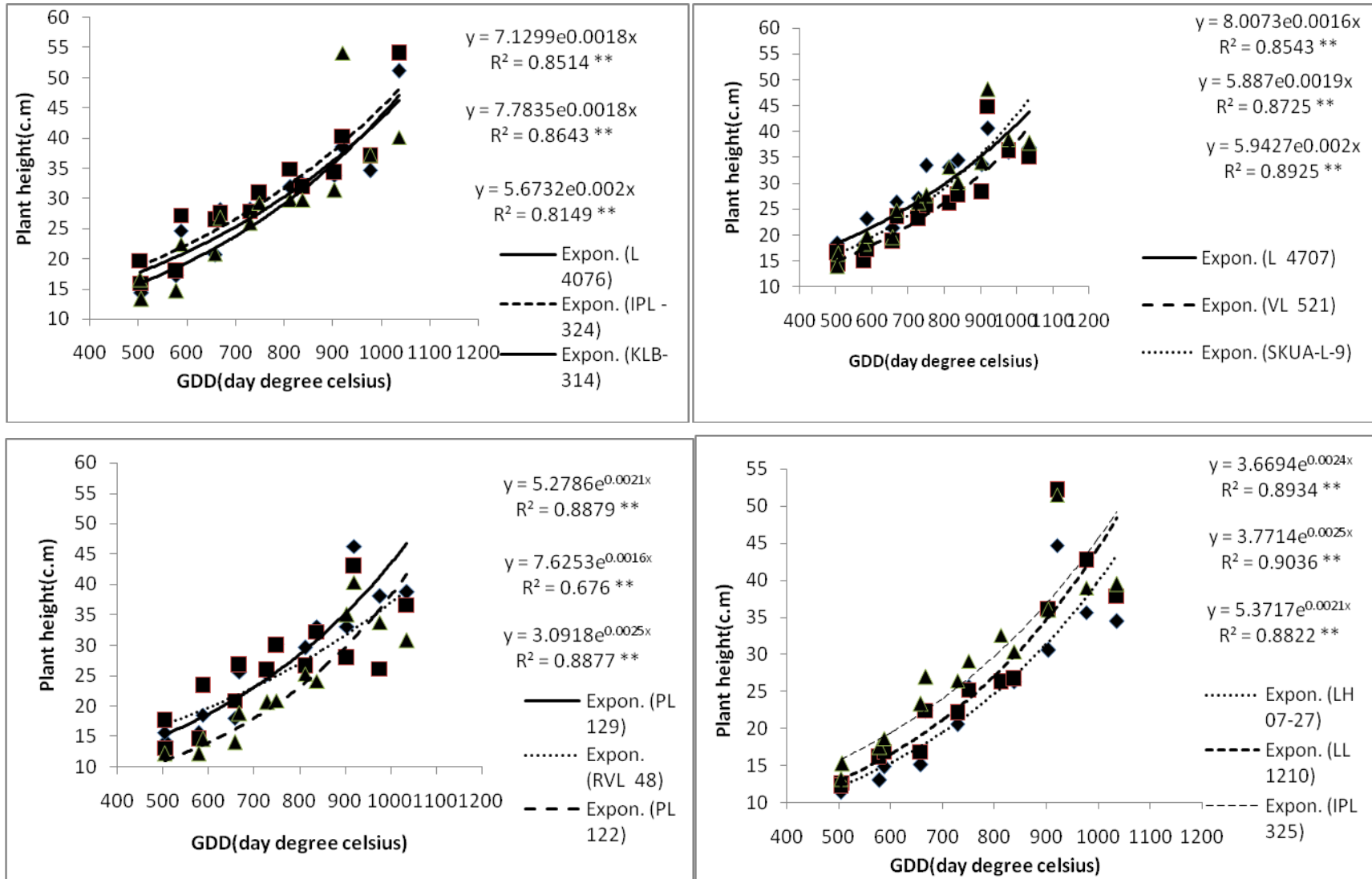
Nath *et al.*, (1999) also reported the similar result in sesamum.

Parya *et al.*, (2009) observed that the GDD might significantly predict the stem weight of wheat crop at the milking stage.

The HTU requirement recorded a variation in different varieties/genotypes in two different experimental years. HTU requirements for the vegetative and reproductive phases varied in two different years even for the same genotypes or varieties.

Both the GDD and HTU significantly affected the plant height. However, they did not affect the dry matter accumulation. The relationship was exponential.

**Fig.1** Effect of growing degree days (GDD) on the plant height of the lentil genotypes / varieties



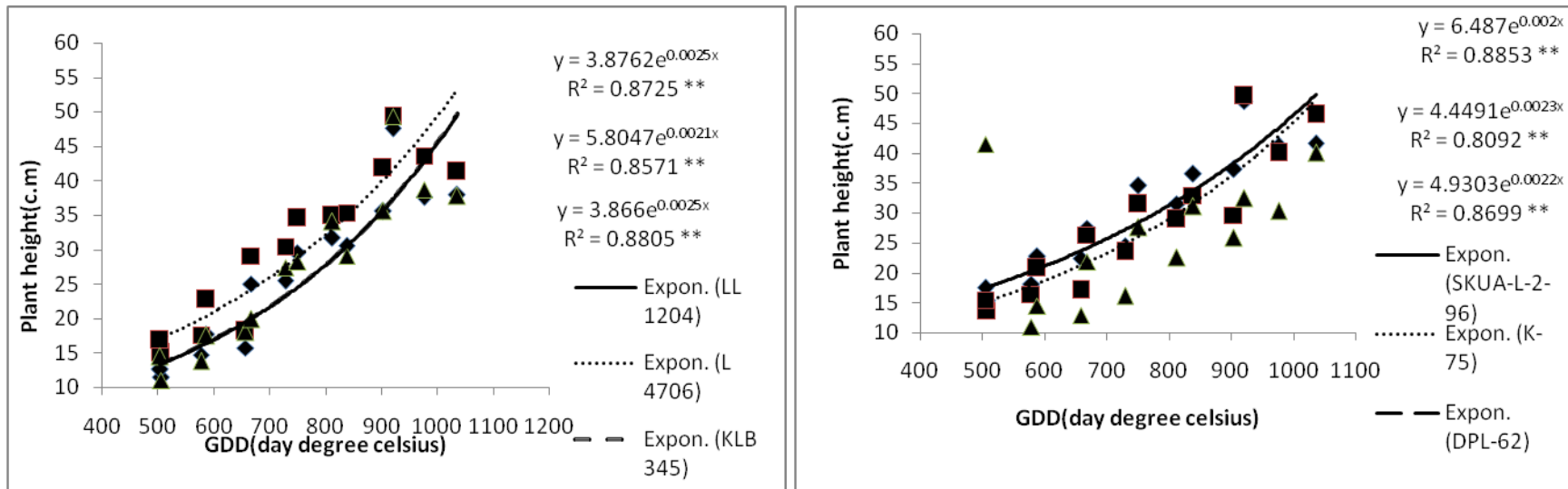
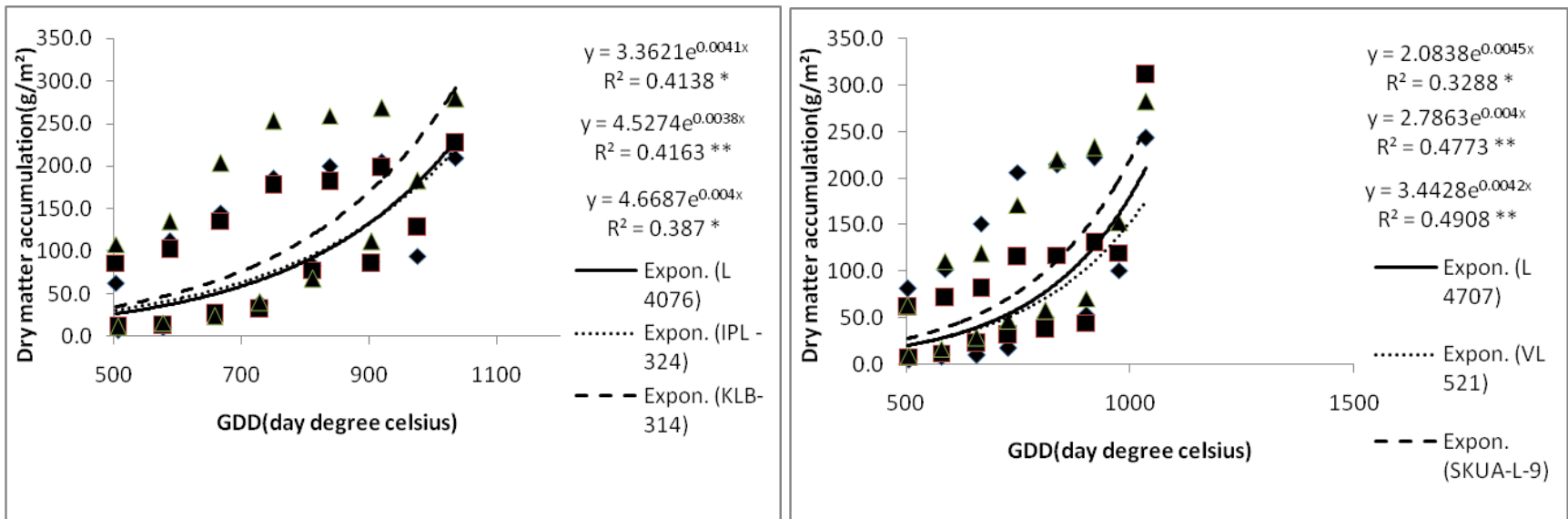


Fig.2 Effect of growing degree days (GDD) on the dry matter accumulation of the lentil genotypes / varieties



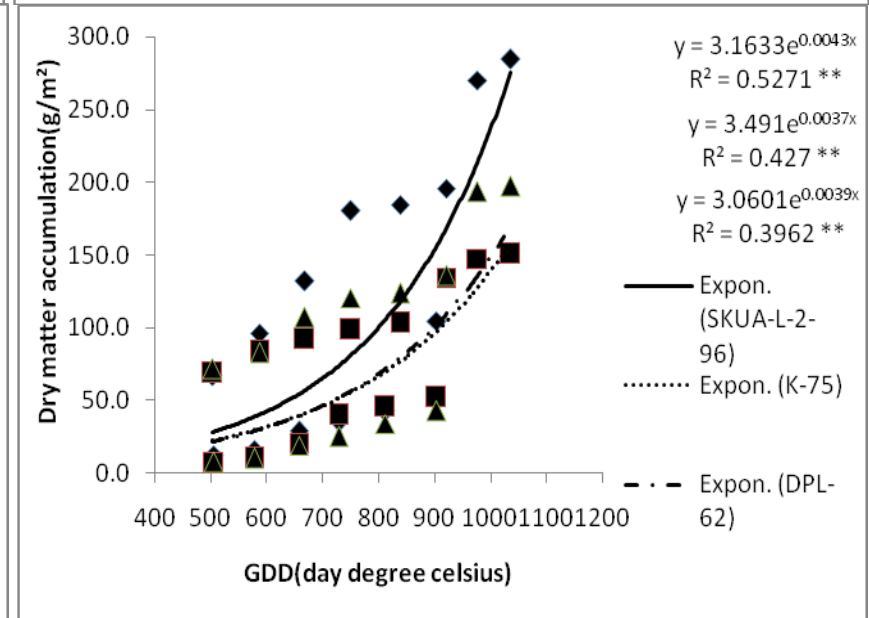
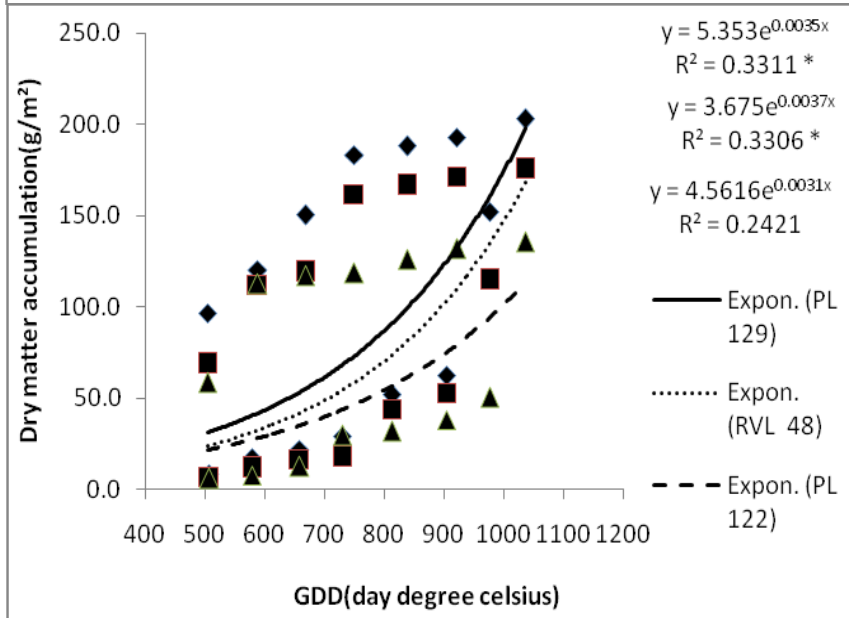
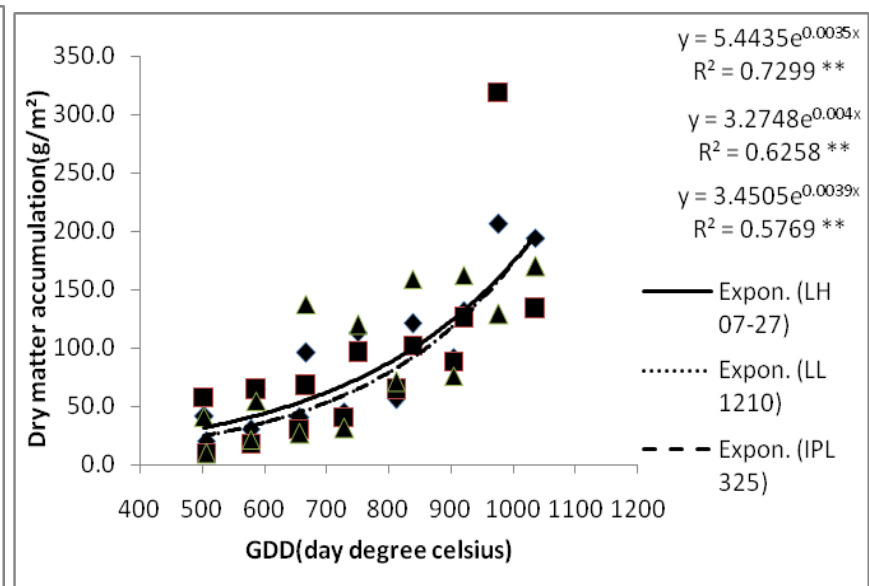
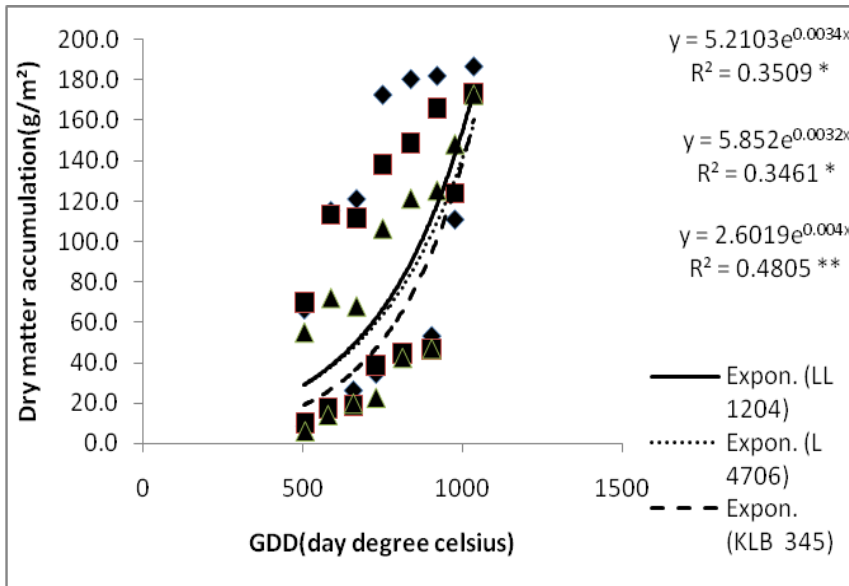
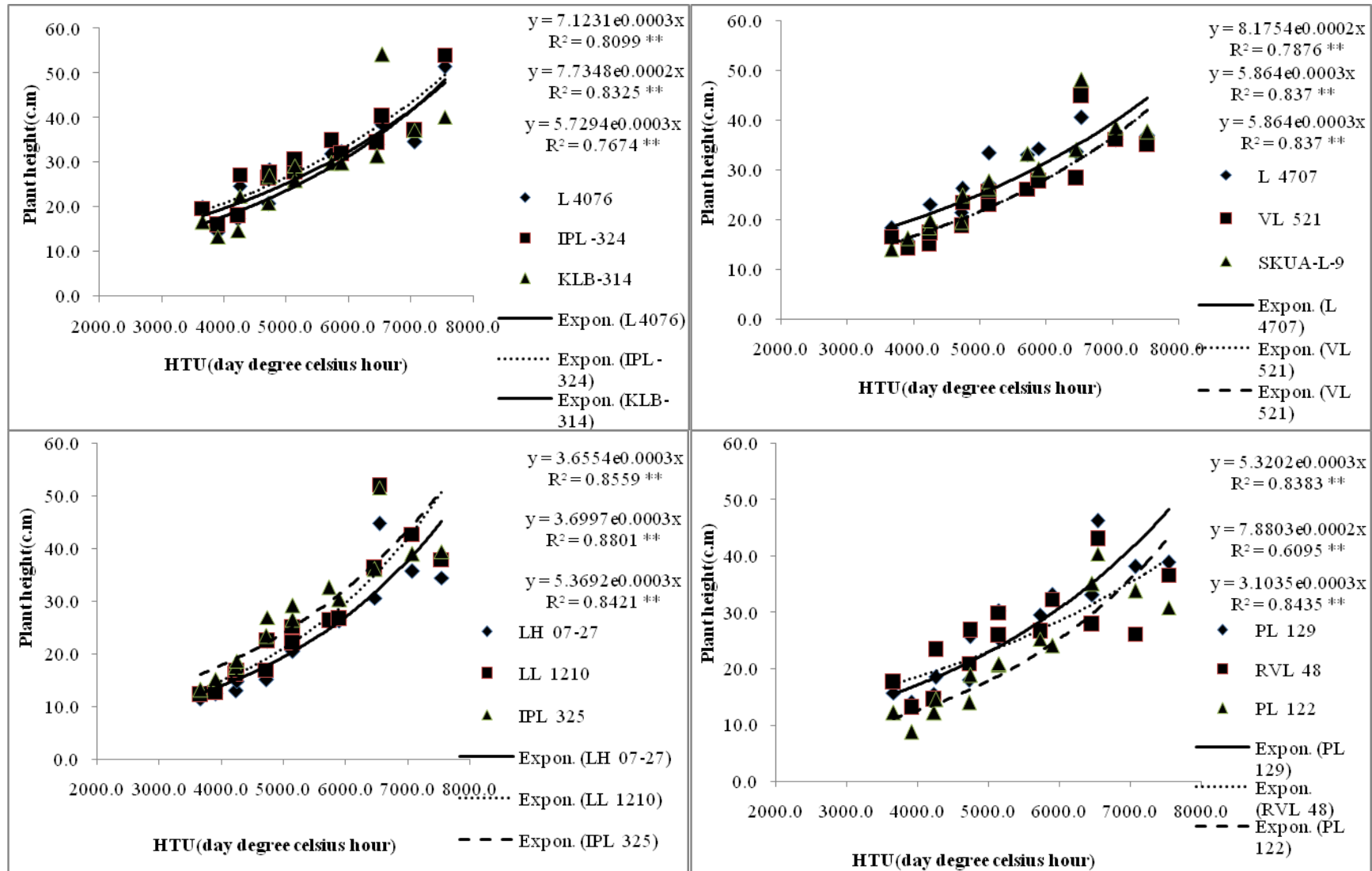


Fig.3 Effect of Heliothermal Unit (HTU) on the plant height of the lentil genotypes / varieties



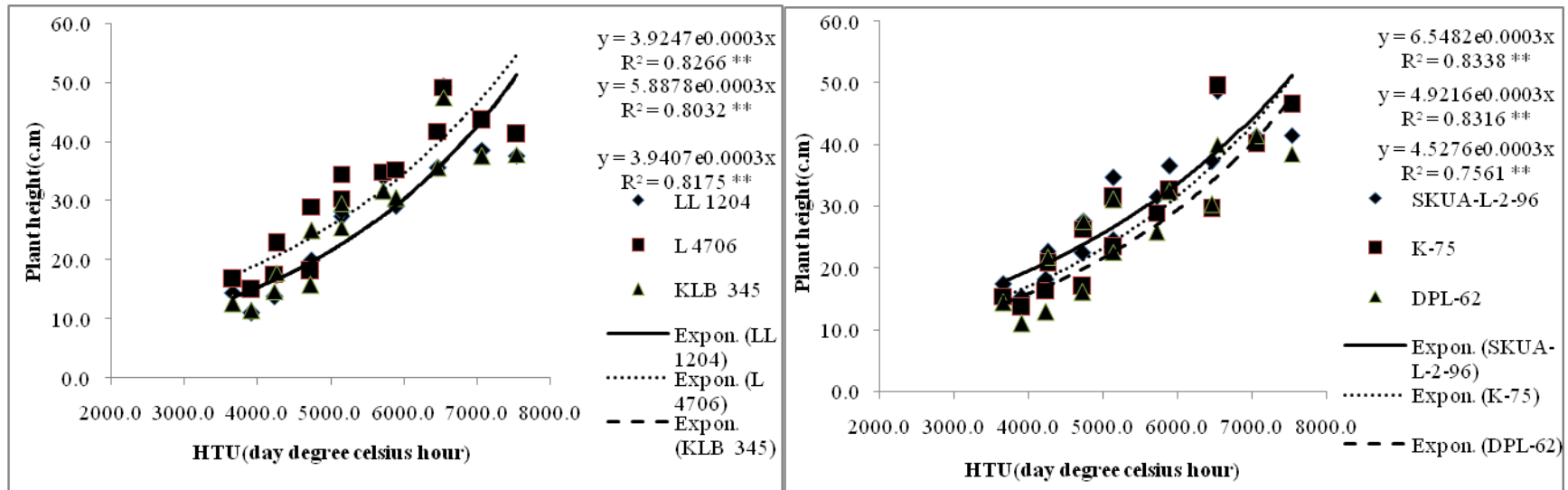
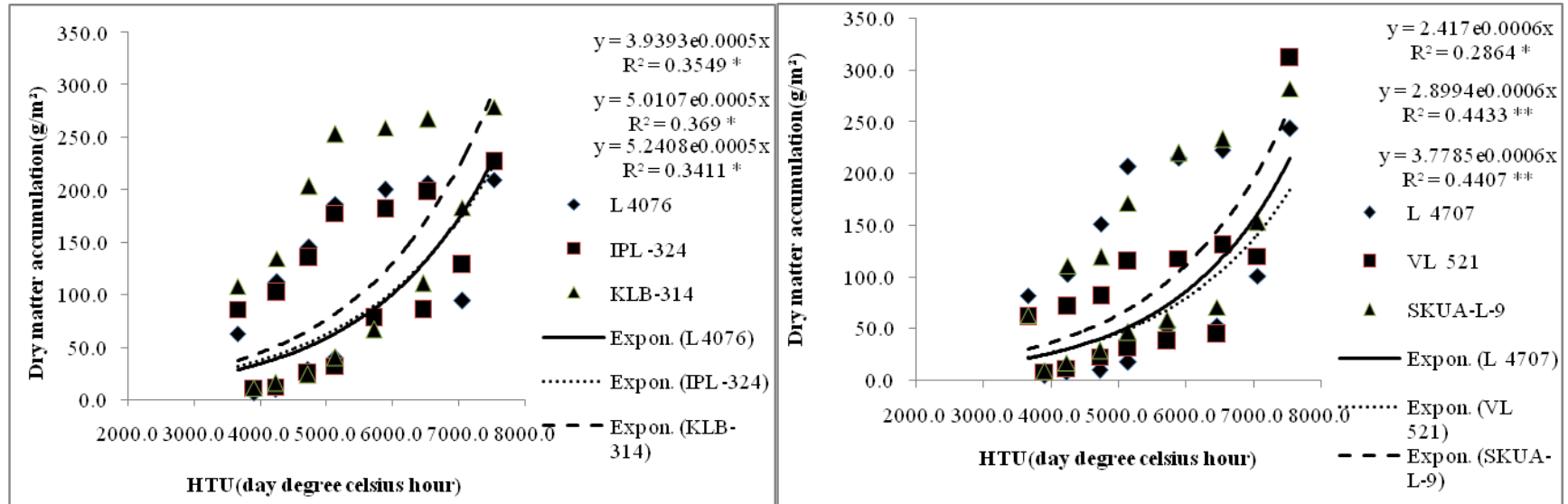
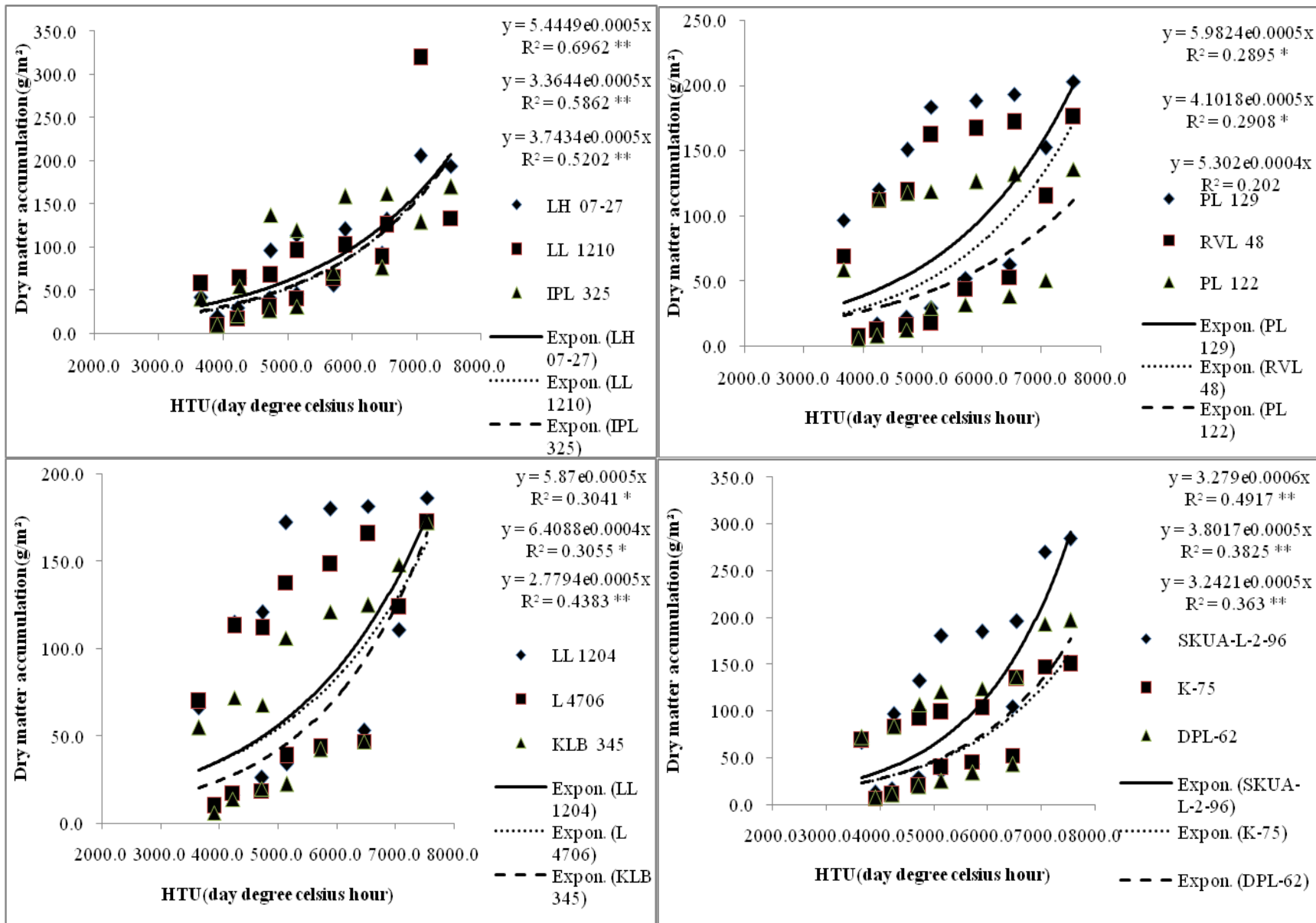


Fig.4 Effect of Heliothermal Unit (HTU) on the dry matter accumulation of the lentil genotypes/varieties







**Table.1** Description of lentil genotypes and varieties used in the experiment

Sl. No.	Entry	Source	Pedigree
1	L 4076	IARI, New Delhi	PI 234 x PL 639
2	IPL -324	IIPR, Kanpur	(IIL 7659 X DPL 58) X KL-178
3	KLB-314	CSA, Kanpur	KL 225 X KLB 97-6
4	L 4707	IARI, New Delhi	L 4650 X L 4076
5	VL 521	VPKAS, Almora	VL 501X (Precoz x L 4076)
6	SKUA-L-9	Srinagar	Sel. From EC 3109
7	LH 07-27	CCS HAU, Hisar	LH 84-8 X L 4641
8	LL 1210	PAU, Ludhiana	LL 699 X FLIP 91 – 51 L
9	IPL 325	IIPR, Kanpur	(IIL 101 X EC 362) X DPL 62
10	PL 129	Pantnagar	PL 639 X L 4188
11	RVL 48	Sehore	JL 1 X DPL 62
12	PL 122	Pantnagar	PL 01 X FLIP 96 – 51
13	LL 1204	PAU, Ludhiana	LL 148 X DPL 58
14	L 4706	IARI, New Delhi	PL 234 X PL 639
15	KLB 345	CSA, Kanpur	Precoz X KLB 231
16	SKUA-L-2-96	Srinagar	KLF 221 X L 1
17	K-75	CSAU, Kanpur	Sel. From Bundelkhand Local
18	DPL-62	IIPR, Kanpur	JL 1 x LG 171

**Table.2** GDD Requirement of lentil genotypes/varieties in different phenophases (Day degree Celsius), 2012-2013 and 2013-2014

Genotypes/ varieties	Sowing-Germination		Sowing-branch initiation		Sowing-flower initiation		Sowing-50% flowering		Sowing-100% flowering		Sowing-maturity	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
L 4076	103.1	130.4	297.3	256.4	729.1	688.8	913.5	848.6	1048.9	1096.6	1348.1	1596.0
IPL -324	121.3	88.1	297.3	242.3	729.1	698.9	913.5	848.6	1026.7	1096.6	1348.1	1576.2
KLB-314	141.6	119.0	326.3	256.4	897.3	688.8	956.3	884.3	1133.2	1140.7	1410.8	1491.8
L 4707	121.3	103.4	197.3	197.3	715.8	667.7	929.5	859.7	1037.7	1080.5	1348.1	1438.5
VL 521	85.1	103.4	283.3	270.7	854.0	688.8	1088.6	884.3	1277.5	1140.7	1870.8	1745.6
SKUA-L-9	103.1	119.0	297.3	270.7	715.8	678.0	956.3	872.2	1048.9	1112.5	1410.8	1438.5
LH 07-27	103.1	135.6	297.3	297.9	913.5	667.7	1088.6	872.2	1294.4	1096.6	1624.8	1657.8
LL 1210	141.6	119.0	326.3	284.7	805.5	688.8	1088.6	884.3	1308.6	1126.2	1481.8	1657.8
IPL 325	121.3	103.4	311.9	270.7	881.7	698.9	967.6	920.7	1117.3	1165.5	1410.8	1533.2
PL 129	85.8	103.4	297.3	284.7	814.1	698.9	913.5	920.7	1103.0	1165.5	1410.8	1491.8
RVL 48	121.3	135.6	297.3	270.7	832.7	688.8	913.5	897.2	1037.7	1140.7	1410.8	1333.3
PL 122	103.1	119.0	297.3	297.9	742.9	678.3	1061.6	884.3	1260.3	1140.7	1624.8	1596.0
LL 1204	103.1	103.4	297.3	284.7	832.7	667.7	1009.4	884.3	1277.5	1152.7	1410.8	1616.3
L 4706	121.3	103.4	326.3	284.7	897.3	678.3	988.9	909.0	1216.3	1126.2	1410.8	1333.3
KLB 345	103.1	135.6	297.3	311.1	805.5	688.8	1007.9	872.2	1277.5	1112.5	1481.8	1596.0
SKUA-L-2-96	103.1	119.0	297.3	297.9	897.3	698.9	978.3	909.0	1277.3	1152.7	1481.8	1657.8
K-75	103.1	119.0	297.3	284.7	1077.3	688.8	1243.7	572.2	1308.6	1152.7	1624.8	1657.8
DPL-62	103.1	119.0	297.3	270.7	832.7	698.9	1088.6	884.3	1277.5	1140.7	1624.8	1657.8

**Table.3** GDD Requirement for the onset of different phenophases in lentil varieties  
(Day degree Celsius), 2012-2013

Genotypes/ varieties	Sowing to Germination	Germination to Branch initiation	Branch initiation to flower initiation	GDD (Vegetative phase)	Flower initiation to 50% flowering	50% flowering to 100% flowering	100% flowering to Maturity	GDD (Reproducti ve stage)
L 4076	103.1	194.2	431.8	729.1	184.4	135.5	299.2	619.1
IPL -324	121.3	176.0	431.8	729.1	184.4	113.3	321.4	619.1
KLB-314	141.6	184.8	571.0	897.3	59.0	176.9	277.6	513.5
L 4707	121.3	76.0	518.6	715.8	213.7	108.2	310.4	632.3
VL 521	85.1	198.2	570.7	854.0	234.6	188.9	593.3	1016.8
SKUA-L-9	103.1	194.2	418.6	715.8	240.5	92.6	361.9	695.0
LH 07-27	103.1	194.2	616.2	913.5	175.2	205.8	330.5	711.4
LL 1210	141.6	184.8	479.2	805.5	283.2	220.0	173.2	676.4
IPL 325	121.3	190.6	569.9	881.7	85.9	149.7	293.5	529.1
PL 129	85.8	211.5	516.8	814.1	99.4	189.6	307.8	596.8
RVL 48	121.3	176.0	535.5	832.7	80.8	124.3	373.1	578.1
PL 122	103.1	194.2	445.7	742.9	318.7	198.7	364.5	881.9
LL 1204	103.1	194.2	535.5	832.7	176.7	268.1	133.3	578.1
L 4706	121.3	205.1	571.0	897.3	91.6	227.4	194.5	513.5
KLB 345	103.1	194.2	508.2	805.5	202.5	269.6	204.3	676.4
SKUA-L-2-96	103.1	194.2	600.1	897.3	81.0	299.0	204.6	584.5
K-75	103.1	194.2	780.0	1077.3	166.5	64.9	316.2	547.6
DPL-62	103.1	194.2	535.5	832.7	255.9	188.9	347.3	792.1

**B.** GDD Requirement for the onset of different phenophases in lentil varieties  
(Day degree Celsius), 2013-2014

Genotypes/ varieties	Sowing to Germination	Germination to Branch initiation	Branch initiation to flower initiation	GDD (Vegetative stage)	Flower initiation to 50% flowering	50% flowering to 100% flowering	100% flowering to Maturity	GDD (Reproduc tive stage)
L 4076	130.4	126.0	432.4	688.8	159.8	248.0	499.4	907.2
IPL -324	88.1	154.2	456.7	698.9	149.7	248.0	479.6	877.3
KLB-314	119.0	137.4	432.4	688.8	195.6	256.4	351.1	803.0
L 4707	103.4	93.9	470.5	667.7	192.0	220.9	358.0	770.8
VL 521	103.4	167.3	418.1	688.8	195.6	256.4	604.9	1056.9
SKUA-L-9	119.0	151.7	407.6	678.3	194.1	240.4	326.0	760.4
LH 07-27	135.6	162.3	369.9	667.7	204.5	224.4	561.3	990.1
LL 1210	119.0	165.7	404.1	688.8	195.6	241.9	531.6	969.1
IPL 325	103.4	167.3	428.2	698.9	221.8	244.8	367.7	834.3
PL 129	103.4	181.3	414.2	698.9	221.8	244.8	326.3	792.9
RVL 48	135.6	135.2	418.1	688.8	208.4	243.6	192.6	644.6
PL 122	119.0	178.9	380.5	678.3	206.0	256.4	455.3	917.7
LL 1204	103.4	181.3	383.0	667.7	216.6	268.4	463.6	948.6
L 4706	103.4	181.3	393.6	678.3	230.7	217.3	207.1	655.0
KLB 345	135.6	175.6	377.7	688.8	183.4	240.4	483.5	907.2
SKUA-L-2-96	119.0	178.9	401.1	698.9	210.1	243.8	505.1	958.9
K-75	119.0	165.7	404.1	688.8	183.4	280.6	505.1	969.1
DPL-62	119.0	151.7	428.2	698.9	185.4	256.4	517.1	958.9

**Table.4** HTU Requirement of lentil genotypes/varieties in different phenophases (Day degree Celsius hour), 2012-2013 and 2013-2014

Genotypes/ varieties	Sowing-Germination		Sowing-branch initiation		Sowing-flower initiation		Sowing-50% flowering		Sowing-100% flowering		Sowing-maturity	
	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14	2012-13	2013-14
L 4076	843.5	796.2	2457.6	1913.7	5436.3	4771.7	6567.8	5951.0	7684.3	8067.5	9887.1	12114.4
IPL -324	977.9	658.1	2458.0	1800.9	5436.0	4777.8	6567.8	5951.0	7475.6	8067.5	9887.1	11910.4
KLB-314	1059.1	925.7	2724.8	1913.7	6446.7	4771.7	6864.2	6235.8	8267.3	8222.8	10523.2	11243.5
L 4707	977.9	796.2	2457.5	1532.3	5343.6	4737.8	6691.0	6041.0	7580.1	7937.5	9887.1	10758.9
VL 521	724.7	796.2	2332.0	2037.1	1646.2	4771.7	7888.4	3235.8	9472.1	8222.8	14740.2	13503.6
SKUA-L-9	843.5	925.7	2332.0	2037.1	5343.6	4770.7	6864.2	6142.2	7684.3	8101.0	10523.2	10758.6
LH 07-27	843.5	1081.3	2458.0	2248.8	6568.0	4737.8	7888.0	6142.2	9632.7	8067.5	12747.4	12697.3
LL 1210	1059.6	925.7	2724.8	2146.3	5803.0	4771.7	7888.4	6235.8	9639.8	8102.4	11262.2	12697.3
IPL 325	977.9	796.2	2591.9	2037.1	6328.1	4777.8	6973.8	6538.3	8119.4	8468.9	10523.2	11620.0
PL 129	843.5	796.2	2457.6	2146.3	5868.4	4777.8	6567.8	6538.3	8003.2	8468.9	10523.2	11243.5
RVL 48	977.9	1081.3	2457.6	2037.0	6004.5	4777.8	6567.8	6338.6	7580.1	8222.7	10523.2	9840.5
PL 122	843.5	925.7	2457.5	2248.8	5447.4	4770.7	7788.4	6235.8	9298.9	8222.8	12747.5	12114.4
LL 1204	843.5	796.2	2457.5	2146.3	6004.5	4737.8	7475.6	6235.8	9472.1	8343.9	10523.2	12327.5
L 4706	977.9	796.2	2724.8	2146.3	6446.7	4770.7	7186.8	6436.5	8918.3	8102.4	10523.2	9840.5
KLB 345	843.5	1081.3	2457.5	2368.1	5803.0	4771.7	7358.7	6142.2	9472.1	8109.0	11262.2	12114.4
SKUA-L-2-96	843.5	925.7	2457.5	2248.8	6446.7	4777.8	7090.9	6436.5	9472.1	8343.9	11262.2	12697.3
K-75	843.5	925.7	2457.5	2146.3	7358.7	4771.7	8003.2	6142.2	9639.8	8343.9	12747.5	12697.3
DPL-62	843.5	925.7	2457.5	2146.3	6004.5	4777.8	7888.4	6235.8	9472.1	8222.7	12747.5	12697.3

**Table.5** HTU requirement onset of different phenophases in lentil varieties (Day degree Celsius hour) in 1<sup>st</sup> year

Genotypes/ varieties	Sowing to Germination	Germination to Branch initiation	Branch initiation to flower initiation	HTU (Vegetative phase)	Flower initiation to 50% flowering	50% flowering to 100% flowering	100% flowering to Maturity	HTU (Reproductive phase)
L 4076	843.5	1614.0	2978.8	5436.3	1131.5	1116.5	2202.8	4450.8
IPL -324	977.9	1480.1	2978.0	5436.0	1131.8	907.9	2411.5	4451.1
KLB-314	1059.1	1665.8	3721.9	6446.7	417.5	1403.1	2255.9	4076.5
L 4707	977.9	1479.7	2886.0	5343.6	1347.5	889.1	2307.0	4543.5
VL 521	724.7	1607.3	2965.5	5297.5	2415.3	1583.8	2854.6	6853.7
SKUA-L-9	843.5	1488.4	3011.6	5343.6	1520.6	820.1	2838.9	5179.6
LH 07-27	843.5	1614.5	4110.0	6568.0	1320.0	1744.7	3114.7	6179.4
LL 1210	1059.6	1665.2	3078.2	5803.0	2085.4	1751.4	1622.4	5459.2
IPL 325	977.9	1614.0	3736.2	6328.1	645.7	1145.6	2403.8	4195.1
PL 129	843.5	1614.0	3410.8	5868.4	699.4	1435.4	2520.0	4654.8
RVL 48	977.9	1479.7	3546.9	6004.5	563.3	1012.4	2943.1	4518.7
PL 122	843.5	1614.0	2989.9	5447.4	2341.0	1510.5	3448.5	7300.0
LL 1204	843.5	1614.0	3546.9	6004.5	1471.1	1996.5	1051.0	4518.7
L 4706	977.9	1747.0	3721.9	6446.7	740.1	1731.5	1604.9	4076.5
KLB 345	843.5	1614.0	3345.5	5803.0	1555.7	2113.4	1790.1	5459.2
SKUA-L-2-96	843.5	1614.0	3989.1	6446.7	644.3	2381.2	1790.1	4815.6
K-75	843.5	1614.0	4901.2	7358.7	644.4	1636.6	3107.7	5388.7
DPL-62	843.5	1614.0	3547.0	6004.5	1883.9	1583.8	3275.3	6743.0

**B. HTU requirement onset of different phenophases in lentil genotypes/varieties (Day degree Celsius hour) in 2<sup>nd</sup> year**

Genotypes/ varieties	Sowing to Germination	Germination to Branch initiation	Branch initiation to flower initiation	HTU (Vegetative phase)	Flower initiation to 50% flowering	50% flowering to 100% flowering	100% flowering to Maturity	HTU(Repro ductive phase)
L 4076	796.2	1117.4	2858.0	4771.7	1179.3	2116.5	4046.9	7342.7
IPL -324	658.1	1142.8	2976.9	4777.8	1173.3	2116.5	3842.9	7132.7
KLB-314	925.7	988.0	2858.1	4771.7	1464.1	1987.0	3020.8	6471.8
L 4707	796.2	736.1	3205.5	4737.8	1303.2	1896.6	2821.3	6021.1
VL 521	796.2	1240.8	2734.6	4771.7	1535.9	4987.0	5280.8	11803.7
SKUA-L-9	925.7	1111.4	2733.6	4770.7	1371.5	1958.8	2657.6	5987.9
LH 07-27	1081.3	1167.6	2489.0	4737.8	1404.4	1925.3	4629.8	7959.5
LL 1210	925.7	1220.6	2625.4	4771.7	1464.1	1866.6	4594.9	7925.6
IPL 325	796.2	1240.8	2740.7	4777.8	1760.5	1930.6	3151.1	6842.2
PL 129	796.2	1350.0	2631.5	4777.8	1760.5	1930.6	2774.6	6465.7
RVL 48	1081.3	955.7	2740.8	4777.8	1560.8	1884.1	1617.8	5062.7
PL 122	925.7	1323.1	2521.8	4770.7	1465.1	1987.0	3891.6	7343.7
LL 1204	796.2	1350.0	2591.5	4737.8	1498.0	2108.2	3983.6	7589.7
L 4706	796.2	1350.0	2624.4	4770.7	1665.9	1665.9	1738.1	5069.8
KLB 345	1081.3	1286.8	2403.6	4771.7	1370.5	1966.8	4005.4	7342.7
SKUA-L-2-96	925.7	1323.1	2529.0	4777.8	1658.7	1907.4	4353.4	7919.5
K-75	925.7	1220.6	2625.4	4771.7	1370.5	2201.7	4353.4	7925.6
DPL-62	925.7	1220.6	2631.5	4777.8	1458.0	1986.9	4474.6	7919.5

**Yield and yield attributes**

Significant differences did exist among the variety regarding the number of branch plant<sup>-1</sup> and number of pods plant<sup>-1</sup>. The maximum seed yield in both the year was recorded in PL-129. In the 1<sup>st</sup> year it was 1712.4 kg ha<sup>-1</sup> and in the 2<sup>nd</sup> year 1602.4 kg ha<sup>-1</sup>. The minimum yield was recorded in VL 521 (336.7 kg ha<sup>-1</sup>). The highly productive four pre released varieties were PL 129, L 4706, SKUA-L-9 and IPL-325.

The remarkable differences observed in different vegetative growth stage in the two experimental year was due to temperature difference in two different experimental years. In the 2<sup>nd</sup> year the crop was exposed to higher minimum temperature than the 1<sup>st</sup> year which led to higher crop height, dry matter accumulation and nodule number in 2<sup>nd</sup> year crops.

During the reproductive phase the 2<sup>nd</sup> year crop was exposed to higher minimum temperature which led to flower drop, drying of the floral part and ultimate reduction of

yield (Tzudir *et al.*, 2014). Erskine *et al.*, (1989) observed that the productivity was related to the temperature during reproductive period. Summerfield *et al.*, (1989) observed that the higher temperature during the reproductive phase accelerated progress towards reproductive maturity and reduced seed yield. In the present experiment the minimum temperature during the reproductive phase in the 1<sup>st</sup> year ranged in between 11.2 and 14.1 °C where as in the 2<sup>nd</sup> year, it was in between 14.1 and 16.8 degree Celsius; there was an approximate rise of 3 °C in the 2<sup>nd</sup> year. The maximum productivity of lentil would be achieved if the maximum and minimum temperatures ranged from 24.6 to 28.6 °C and 10.1 to 10.9 °C during 100% flowering stage.

In the Gangetic Plain of West Bengal four pre released varieties, PL 129, L 4706, SKUA-L-9 and IPL 325 may be selected for their better productivity. Sowing time should be selected in such manner that the flowering stage will be reached when the maximum and minimum temperatures will hover around 24.6 to 28.6 °C and 10.1 to 10.9 °C respectively.

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