PUNJAB MASOOR-2019: A NEW LENTIL VARIETY RELEASED IN PAKISTAN HAVING HIGH YIELD POTENTIAL AND OTHER AGRONOMIC TRAITS

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ABSTRACT: The basic aim of this study was to aware the farmers regarding new lentil variety that has been released for all areas of Punjab province. Punjab Masoor-2019 was an outcome of hybridization of (NARC-02-2 X 01505) followed by bulk-pedigree method of selection. This variety was tested in a series of trials on research stations and throughout the Lentil growing areas of Punjab and it out yielded check variety Pb.M-2009. In National Uniform Yield Trial, it surpassed the check variety Pb.M-09 Its maximum yield potential of 2529 kg/ha was achieved when sown on (25-10-17) in 2nd date of sowing trial. The new variety is moderately resistant to Lentil Rust and Botrytis Grey Mold disease. In addition to this, proposed variety is suitable both for normally irrigated and water stress condition.One of its unique characters is that it has 3seeds/pod and 4-5pods/node. It contains more protein i.e. (29.2 %) as compared to check variety Pb.M-09 (28.0%). It has better cooking qualities as compared to check variety. Punjab Masoor-2019 is suitable for all areas of Punjab.

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Keywords: New variety; Lentil; PUNJAB MASOOR-2019; Masoor and cooking quality

INTRODUCTION

Lentil (*Lens culinaris*Medikus l), is the second most important rabi pulse crop after chickpea in Pakistan. It contains 28% protein and used as a rich source of dietary proteins in many developing countries (Karimizadeh*et al.*,2012) Every year protein demand is increasing to feed the rising population of the county therefore, its necessary to develop high yielding and disease resistant varieties of lentil (Erskine *et al.*,2011)

Worldwide yearly production and cultivated lentil area are about 4.95 million ton and 4.39 million ha respectively (FAO 2016). Mostly world lentil production is primarily coming from India 36%, Canada 17% and Turkey 15%. Other neighboring countries of Pakistan like Nepal 14%, Bangladesh 3% and Iran 3% also have a much higher share by producing 165, 119 and 115 thousand tones as compared to Pakistan 6.4 thousand tones in 2018- 19(Economic Survey of Pakistan 2018-19).

The main reason of low production of lentil was due to non-availability of pure seed of high yield potential varieties having inbuilt resistance against abiotic stresses along with wide adaptability (Abdipar*et al.*, 2011). All these traits are essentially required to be incorporated in the improved germplasm to compete economically with other crops of rabi season like wheat and rice.

All morpho-physiological traits simultaneously effect the yield at different growth stages. Any change or disturbance in any of these traits due to biotic orabiotic stresses on plant during vegetative and reproductive growth stages decreases the yield (Tyagi and Khan 2010)

Lentil suffers from a number of diseases which are caused by fungi, bacteria, viruses, nematodes and phanerogamic plant parasites. These are responsible for the deterioration of seed quality, seed rots, seedling morality and stem and root disease. Foliar diseases are gaining importance in several countries. These diseases reduce the vigour of the plant, threatening its life and ultimately minimizing yields. Fusarium wilt, Botrytis grey mould and collar rot are common disease of lentil.

Wilt causes 5-10% yield losses, but sometimes severe damage may occur which results in complete failure of the crop depending upon the crop stage at which it attacks and severity of the pathogen.

Rust causes 100% crop failure when the favorable weather conditions exist. Lentil rust caused by U.fabae is widely spread in South Asia and characterized by lesions on the stems and leaves, Leaves drop and premature plant death. Losses from the disease has been estimated up to 70%.

Botrytis grey mould (BGM) of lentil, caused by the fungal pathogens Botrytis fabae and B.cinerea, is a serious, but sporadic disease. Botrytis cinereal has been found to be a problem in lentil production in Pakistan (Acero F.J.F.2006) Ascochyta blight and Botrytis grey mould are wide spread problems damaging 30% of the plants or total failure in some fields depending on the soil conditions and crop environment (Davidson *et al.*,2016)Resistance to Botrytis Grey Mould is poorly understood, but requires a better understanding to enable different sources of resistance to be utilized and subsequent pyramiding of resistance genes (Williamson *et al.*, 2007)

Breeding for host plant resistance is the most effective, efficient and environmentally friendly method to control the disease and it is need of the hour, because reduction in the area is mainly because of low productivity of the available germplasm and due to lack of resistance against abiotic and biotic stresses including diseases.

To increase per unit area of crop it is necessary to evolve high yielding lentil germplasm by selection of plant type that bear more number of branches, more pods, bold seed size with spotted seed coat color, Earliness in maturity with desirable plant height along with vigorous plant growth to escape from weeds to overcome and to identify newer sources of resistance against major diseases and their uses in the breeding program to develop varieties possessing inbuilt resistance against major diseases (Chuhan and Singh 2001; Yadav *et al.*, 2003 Younis et al ., 2008 and Bicer and Sarkar, 2010)

The present study focused on analysis of yields related traits of new variety of lentil for Punjab region. The outcomes of the research will benefit creation of genetic variability by utilized diversified genetic material having wider genetic base, selection of desirable ideotypes and evaluation of new genotypes in yield trials at different environmental zones.

MATERIALS AND METHODS

Punjab Masoor-2019 is a high yielding both under drought (having maximum root length) and normal condition,moderately resistant for lentil rust and Botyritus grey mold. Its yield performance remained very good throughout the evaluation studies. It produced an overall higher grain yield over check variety Pb.M-09. Punjab Masoor-2019 produced 5.31% and 5.98% higher grain yield than the check variety in Preliminary&Advanced Yield Trials, respectively. It consistently surpassed the check with 18.07 % higher grain in Micro yield trial conducted at different locations. The purposed variety Punjab Masoor -2019 out yielded check varieties in National Uniform Yield Trials by 5.66 % and 2.28% increase in grain yield in 2013-14 and 2015-16 respectively. On over all bases, in all the trials, it produced higher yield than standard check.

Table 1. Chronological stages for selection of variety Punjab Masoor-2019 Detail of Hybridization and Selection

Year	Filial generation / trial	Operation
2003-4	Cross was attempted	F_0 harvested
2004-5	F_1	F_1harvested
2005-6	F_2	Bulked
2006-7	F_3	Bulked
2007-8	F_4	Selection of superior single plants
2008-9	F_5	Selection of superior single plants
2009-10 F_6		Pure line selection
2010-11 Preliminary Yield Trial		Yield Data
2011-12 Advanced Yield Trial		
2012-13 Micro Yield Trial		
2013-14 National Uniform Yield Trial		
2015-16 National Uniform Yield Trial		
2015-16 Distinguished Uniformity Stability		
2016-17 Distinguished Uniformity Stability		

Hybridization

Parental lines (male and female) i.e. Source populations were sown alternatively in November ,2003 maintaining 30 cm row to row and 4 cm plant to plant distances. Crossing between parental lines was made early in the morning at research farm of Pulses Research Institute. Emasculation of female flower was done before pollen shedding early in the morning while pollinating immediately with male parent. The emasculation and pollination techniques were followed as described by Singh (7). F0 seeds were harvested from female parent and advanced to F1 population by space planting.

Generation advancement (F1-F6)

A single row of 4m length of F1 hybrid seed was sown along with parental lines. The seeds were planted by dibbling maintaining 4 cm plant to plant and 30cm row to row distances. Selection of single plants were made in F4 generation for desirable plants and continued upto F5 generation. Pure line was selected from F6 generation which was tested for yield in Preliminary yield trial during 2010-11.

Evaluation in different yield trials

Variety Punjab Masoor-2019 was first tested in Advanced yield trial in 2011-12 before evaluating it consecutively for three years in station yield trials,two years agronomic trials and two years in National Uniform advanced yield trial and two years studies were done in Distinguished Uniformity Stability. Fertilizer trials and studies under drought conditions were also conducted for two years. Sowing was done around Last week of October. All yield trials were laid out in RCBD with three replications except national uniform yield trials (according to instructions of coordinator Pulses). The row to row and plant to plant distances were maintained at 30 cm and 4 cm, respectively. Planting was done with single row drill in four rows of four-meter length. Plant population was maintained by thinning at seedling stage. One to two standard checks were included in every experiment for comparison. Disease reaction for the Lentil Rust and Botrytis Grey Mold was also recorded under artificially inoculated conditions following Reddy and Singh(5).

RESULTS AND DISCUSSION

StationYield Trials

The results (Table 2) revealed that Punjab Masoor-2019 (PLL-10502)has highest yield of 1922 kg/hawith 5.05% increase over Punjab Masoor-09 and 16.75% increase over NL-06 in 2010-11. While PLL-10501 has the second highest yieldof 1870 kg/hawith 2.46% and 14.43% increase over Punjab Massor-09 and NL-06 as compared to standard checks Pb. M-09 and NL-06 with yield 1825 kg/ha and 1600 kg/ha respectively, in preliminary yield trials (2010-11). In advance yield trials(Table-3)results showed thatPLL-10502 has the highest yield of 1319 kg/ha as compared to standard checks NL-06 (20.56% increase) and Pb. Masoor-09 (3.85% increase)with yield 1270 kg/ha 1094 kg/ha respectively.

Table 2: Yield performance in kg/ha of different genotypes in Preliminary Yield Trial during 2010-11.

Sr.No.	Entries	Yield (kg/ha.)	Percentage Increase/decreaseOverPb.M-09	Percentage Increase/decreaseOverNL-06
1.	**PLL-10502**	1922	5.05	16.75
2.	PLL-10501	1870	2.46	14.43
3.	**Pb.M-09**	1825	-	12.33
4.	**NL-06**	1600	-12.33	-
5.	PLL-10507	1575	-13.69	-1.56
6.	PLL-10506	1489	-18.41	-6.94
LSD(0.05)= 185.63, CV(%)= 14.3				

Graph-1: Graphical representation of yield performance in kg/ha of different genotypes in Preliminary Yield Trial during 2010-11.

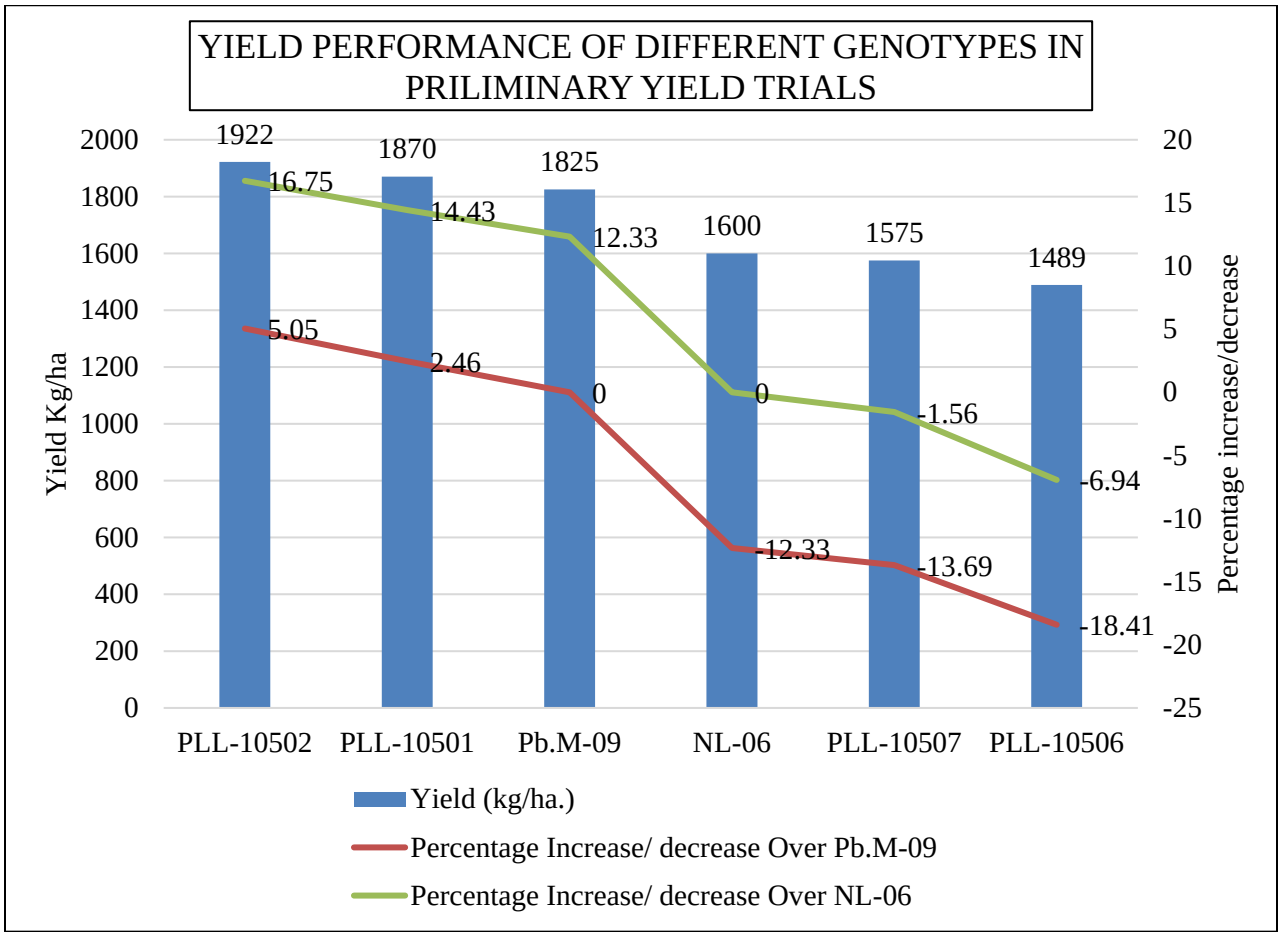
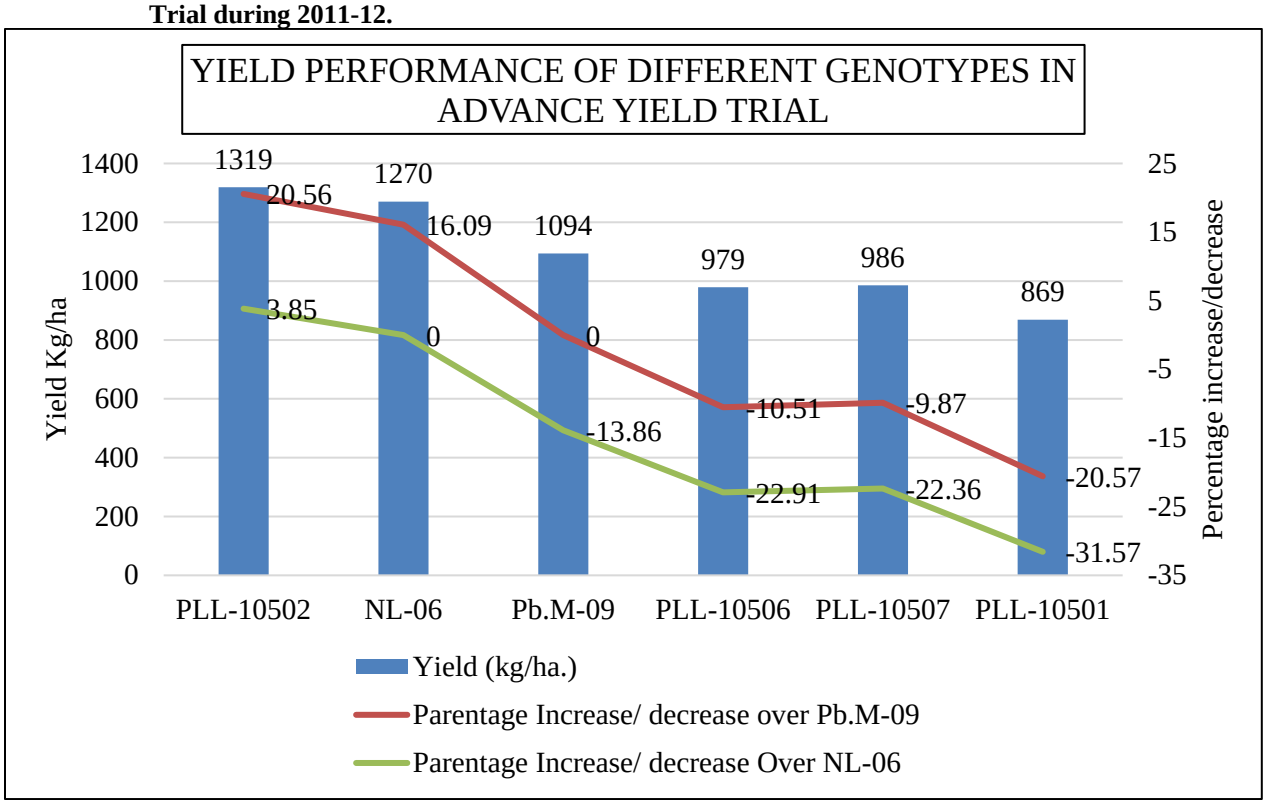


Table 3: Yield performance in kg/ha of different genotypes in Advanced Yield Trial during 2011-12.

Sr.No.	Entries	Yield(kg/ha.)	Parentage Increase/decreaseoverPb.M-09	Parentage Increase/decreaseOverNL-06
1.	**PLL-10502**	1319	20.56	3.85
2.	**NL-06**	1270	16.09	-
3.	**Pb.M-09**	1094	-	-13.86
4.	PLL-10506	979	-10.51	-22.91
5.	PLL-10507	986	-9.87	-22.36
6.	PLL-10501	869	-20.57	-31.57
LSD(0.05)= 59.83, CV(%)= 10.54				

Graph-2: Graphical representation of yield performance in kg/ha of different genotypes in Advance Yield Trial during 2011-12.



Micro Yield Trial:

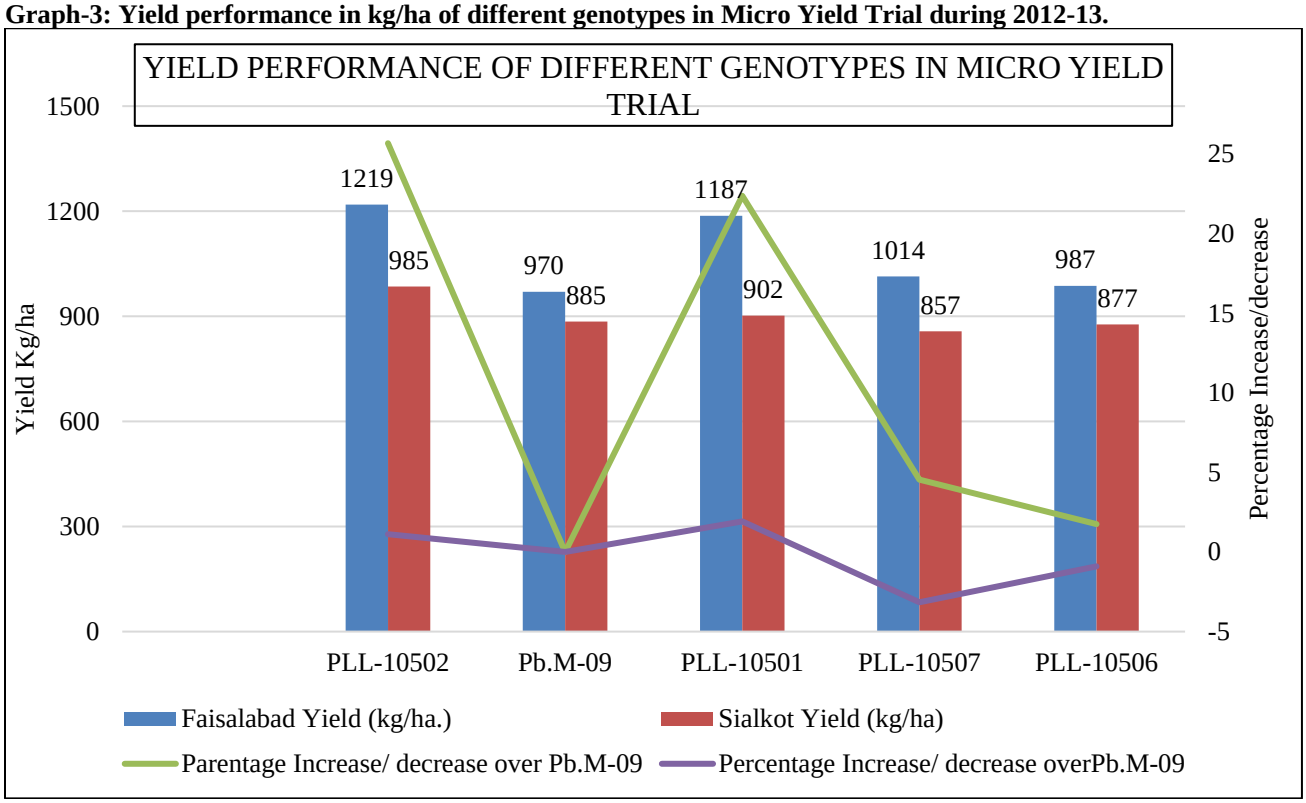
In micro yield trials (Table-4) PLL-10502 has the highest yield 1219 kg/ha with 25.67 % increase over Punjab Masoor-09 in Faisalabad and 985 kg/ha with 1.12 % increase over Punjab Masoor-09 in Sialkot.

PLL-10501 and PLL-10507 ranked 3nd and 4rd with yield 1187 kg/ha and 1014 kg/ha in Faisalabad and 902 kg/ha and 857 kg/ha in Sialkot during the year 2012-2013. On an average new variety Punjab Masoor-2019 gave more yield of kg per hectare as compared to checks in preliminary yield trials, advance yield trials and micro yield trials. On overall bases it out yielded check variety upto 9.94 percent increase.

Table 4: Yield performance in kg/ha of different genotypes in Micro Yield Trial during 2012-13.

Sr.	Entries	FaisalabadYield (kg/ha.)	Parentage +/- overPb.M-09	Sialkot Yield(kg/ha.)	Percentage +/- overPb.M-09
1.	**PLL-10502**	1219	25.67	985	1.12
2.	**Pb.M-09**	970	-	885	-
3.	PLL-10501	1187	22.37	902	1.92
4.	PLL-10507	1014	4.54	857	-3.16
5.	PLL-10506	987	1.75	877	-0.90
LSD(0.05) = 142.8, CV(%) = 12.72				**LSD(0.05) = 178.2, CV(%) = 13.5**	

Graph-3: Yield performance in kg/ha of different genotypes in Micro Yield Trial during 2012-13.



Studies under drought and normal conditions

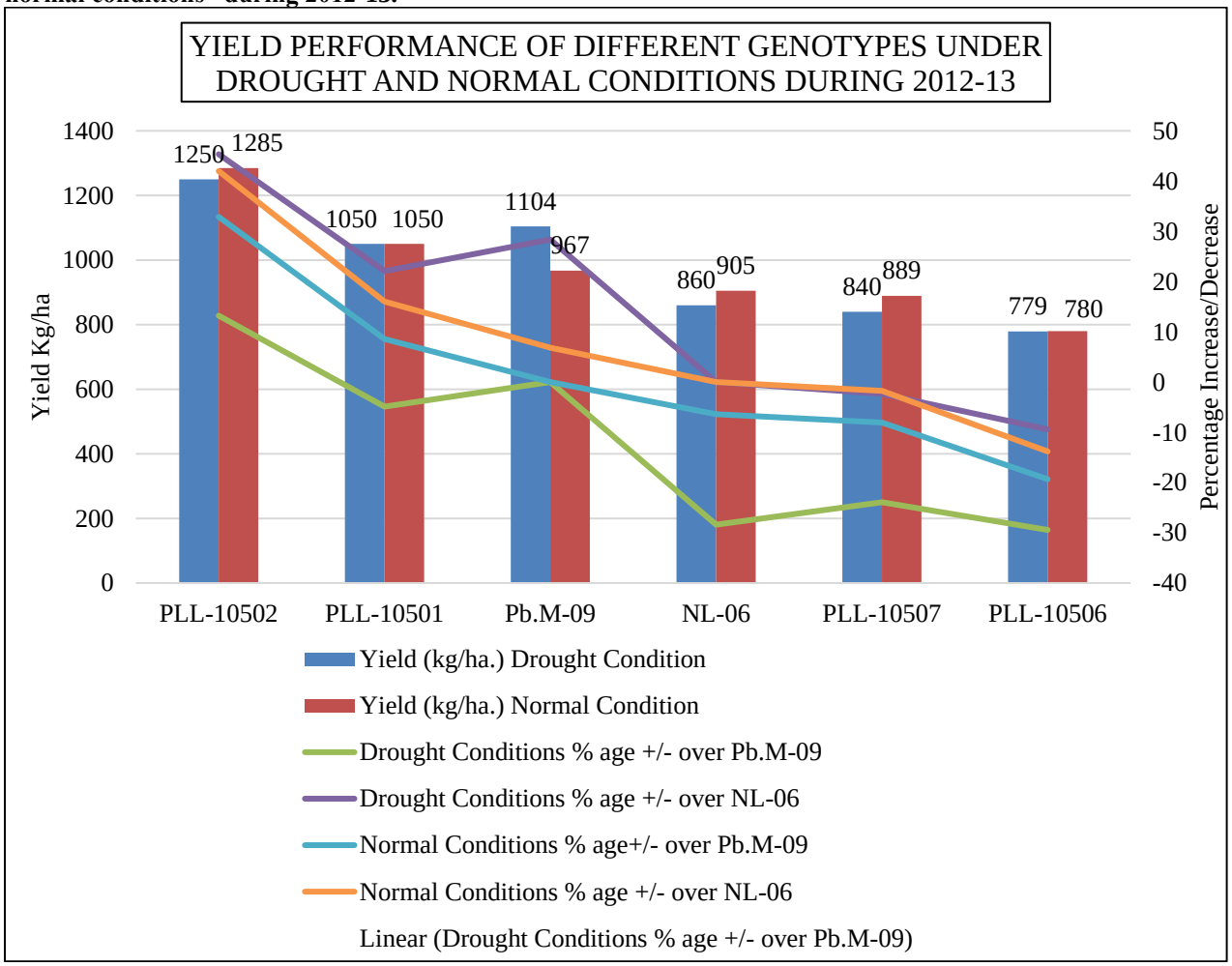
Trials under drought and normal conditions were conducted at Pulses Research Institute, Faisalabad during 2015-2016 and repeated same trial during 2016-17 under both conditions as drought as well as normal. Same genotypes were also tested in PVC(poly vinyle chloride) pipes in sand media.

The results of Table-5 demonstrated that Punjab Masoor-2019 (PLL-10502) has high yield 1250 kg/ha with 13.22 and 45.35 percent increase over Punjab Masoor-09 and NL-06under drought conditions while highest yield of 1285 kg/ha with 32.88 and 41.99 percent increase over Punjab Massor-09 and NL-06 respectively under normal conditions.

Table 5: Yield performance in kg/ha of different genotypes in"Evaluation of advance lines under drought and normal conditions" during 2012-13.

				Under Drought Conditions		Under Normal Conditions	
Sr. #	**Entries**	**Yield (kg/ha.) Drought Condition**	**Yield (kg/ha.) Normal Condition**	**Percentage +/-over Pb.M-09**	**Percentage +/-over NL-06**	**Percentage +/- over Pb.M-09**	**Percentage +/-over NL-06**
1.	**PLL-10502**	1250	1285	13.22	45.35	32.88	41.99
2.	PLL-10501	1050	1050	-4.89	22.09	8.58	16.02
3.	**Pb.M-09**	1104	967	-	28.37	-	6.85
4.	**NL-06**	860	905	-28.37	-	-6.41	-
5.	PLL-10507	840	889	-23.91	-2.32	-8.06	-1.76
6.	PLL-10506	779	780	-29.43	-9.41	-19.33	-13.81
		LSD (0.05) = 185.63, CV (%) = 14.3					

Graph-4: Graphical representation of yield performance in kg/ha of different genotypesunder drought and normal conditions" during 2012-13.



National Uniform Yield Trials

These trials were conducted consecutively for two years (2013-14 to 2015-2016) across the country. The data (Table-6) showed that average grain yield of variety Punjab Masoor-2019 was 1028 kg per hectare as compared to standard variety Pb. M. 2009 yield 1005 kg in 2015-16 while in 2013-14, Punjab Masoor-2019 yield was 877 kg per hectare as compared to standard variety Pb. M. 2009 yield 830 kg/ha with 5.66 percent increase. Its potential yield of 2125 kg per hectare was achieved in 2015-16 at QAARI, Larkana.

Table 6:Yield performance of Punjab Masoor-2019 in National Uniform Yield Trials

Year	Locations	Pb.M-2019	Pb.M-2009	Percentage increase
2013-14	**8**	**877**	**830**	**5.66**
2015-16	**8**	**1028**	**1005**	**2.28**
2015-16: Coefficient of variation= 27.71% Genotypes(G), Locations (L) and GxL interactions are highly significant (P<0.01)				

Agronomic studies

Planting date studies trials were conducted at Pulses Research Institute, Faisalabad during 2016-2017to fix specific agronomic requirements of the variety Punjab Masoor-2019. The results of Table 7 depicted that Punjab Masoor-2019 has highest yield (693 kg/ha on 30th October, 682 kg/ha on 15th November and 291 kg/ha on 30th

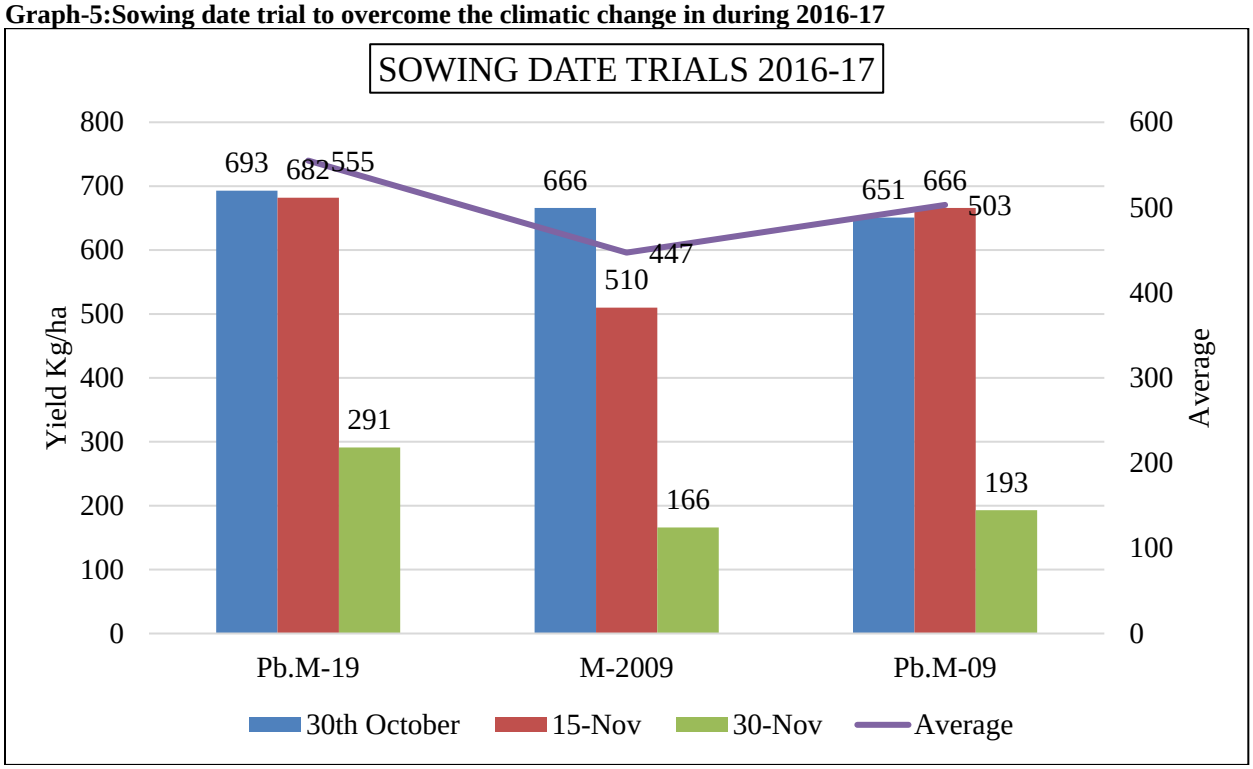
November) among the check varieties M-2009 and Pb. Masoor-2009 at different sowing dates.It was observed that the new strain adheres to the existing production technology and needed no special treatments.

Table: 7 Determination of proper sowing date to overcome the climatic change in during 2016-17

Sr.No.	Genotypes	30th October	15thNovember	30thNovember	Average
1.	Pb.M-19	693	682	291	555
2.	M-2009	666	510	166	447
3.	Pb.M-09	651	666	193	503
Mean		670	619	217	

CV for repsxsowing=10.67 CV for repsxsowingxentries=13.55
LSD (0.05) varieties =67kg/ha LSD (0.05) sowing dates=51kg/ha

Graph-5:Sowing date trial to overcome the climatic change in during 2016-17



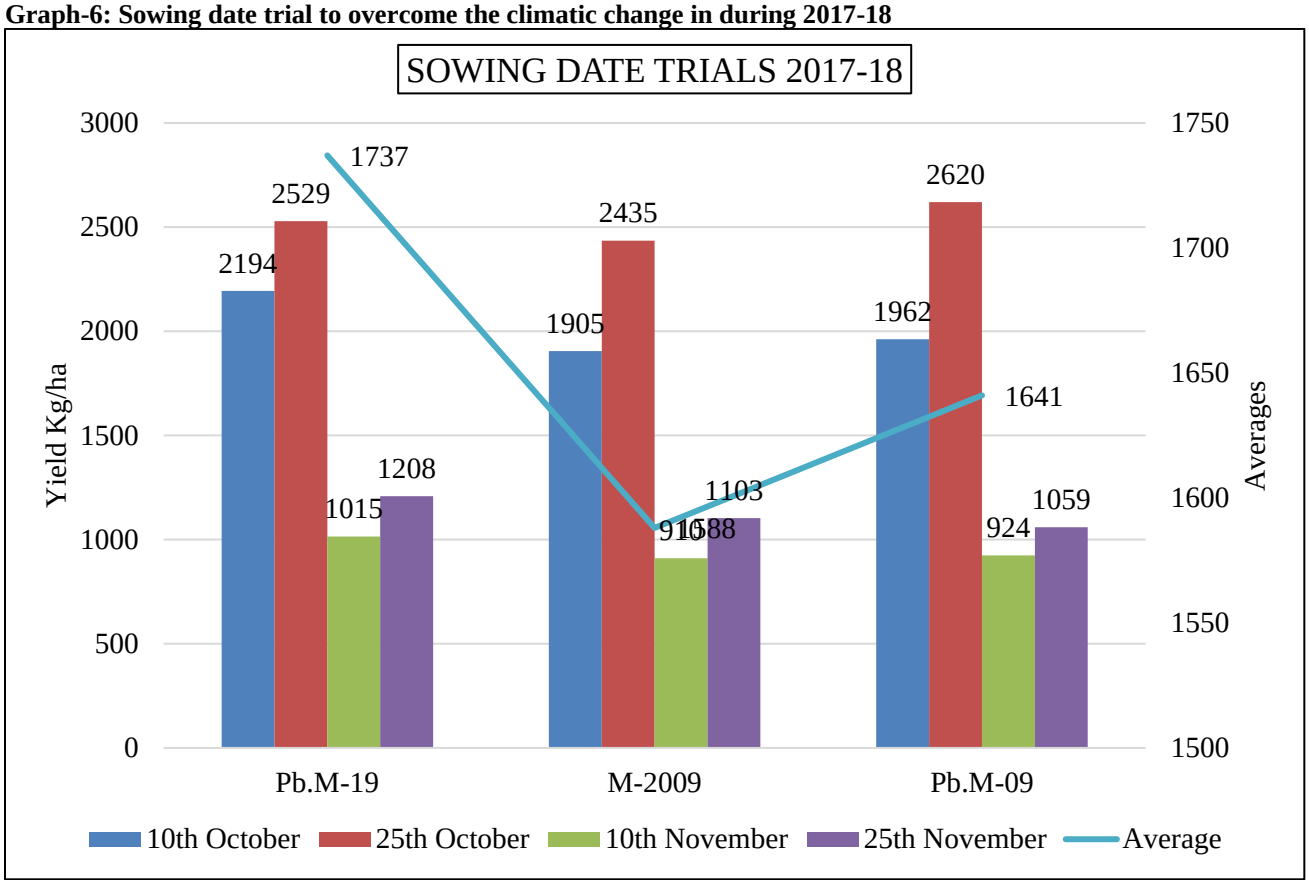
The results of Table-8 depicted that Punjab Masoor-2019 has highest yield (2194 kg/ha on 10th October, 2529 kg/ha on 25th October, 1015 kg/ha on 10th November and 1208 kg/ha on 25th November) among the check varieties M-2009 and Pb. Masoor-2009 at different sowing dates.

Table:8 Determination of proper sowing date to overcome the climatic change in during 2017-18

Sr.#	Genotypes	10th October	25th October	10th November	25th November	Average
1.	Pb.M-19	2194	2529	1015	1208	1737
2.	M-2009	1905	2435	910	1103	1588
3.	Pb.M-09	1962	2620	924	1059	1641
Mean		2020	2528	950	1123	

CV for repsxsowing=12.90 CV for repsxsowingxentries=23.69
LSD (0.05) varieties =76kg/ha LSD (0.05) sowing dates =61kg/ha

Graph-6: Sowing date trial to overcome the climatic change in during 2017-18



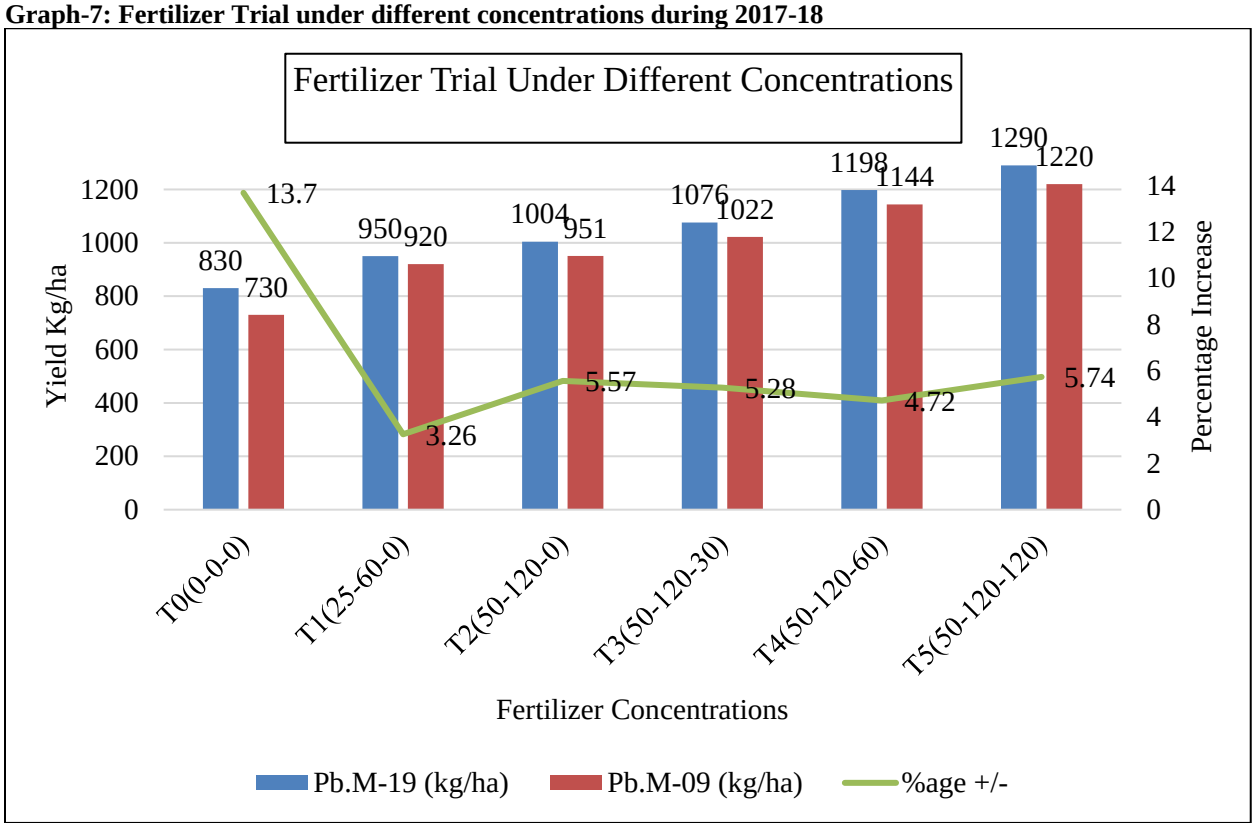
Fertilizer trials

Fertilizer trials were conducted at Pulses Research Institute, Faisalabad during 2017-2018 to fix specific fertilizer requirements of the variety Punjab Masoor-2019.The variety was tested with check variety Punjab Masoor -2009 and gave better yield in all the fertilizer levels. It was observed that the new variety adheres to the existing production technology and needed no special treatments.

Table 9: Fertilizer Trial under different concentrations during 2017-18

Fertilizer level N-P-K(kg/ha)	Pb.M-19 (kg/ha)	Pb.M-09 (kg/ha)	%age +/-
T_0(0-0-0)	830	730	13.7
T_1(25-60-0)	950	920	3.26
T_2(50-120-0)	1004	951	5.57
T_3(50-120-30)	1076	1022	5.28
T_4(50-120-60)	1198	1144	4.72
T_5(50-120-120)	1290	1220	5.74
Average	1058	998	

Graph-7: Fertilizer Trial under different concentrations during 2017-18



Quality Characteristics

This new candidate line is suitable for staple purpose both as whole as well as split (Dhall). It contains more protein i.e. (29.2%) as compared to check variety Pb.M-09 (28.0%).

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پوسٹ ہارویسٹ ریسرچ سنٹر
ایوب زرعی تحقیقاتی ادارہ فیصل آباد۔

No. 160 /
Dated, Faisalabad the
08-03-18

To

The Director,
Pulses Research Institute,
Faisalabad,

Subject: **ANALYSIS OF LENTIL SAMPLES**
Ref: Your LETTER No.329 dated :07-03-2018

Kindly find enclosed herewith the analysis report of 02 Lentil samples.

Verities/Lines	Dry Matter (%)	Ash (%)	Crude Fat (%)	Crude Protein (%)	Phosphorus (%)
Punjab Masoor 2000	94.0	2.90	0.82	28.0	0.32
10502	93.8	2.85	0.88	29.2	0.34

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Diseases Reaction

LentilRust and Botrytis Grey Mold.

The screening studies were carried out at Pulses Research Institute AARI, Faisalabad. The Punjab Masoor-2019 was moderately resistant to lentil Rust and Botrytis Grey Mold.

Table 10: Disease Reaction on Lentil genotypes

Genotypes	Lentil Rust	Botrytis Grey Mold
Pb.M-19	MR	MR
Pb.M-09	S	MS

HR= Highly Resistant (Less than 1% of Plants infected), R = resistant (1-10%), MR = Moderately Resistant (11-20%), S= Susceptible (21-50%), HS= Highly Susceptible (>50%).

Spot Examination

The strain was evaluated by spot examination committee on 20-03-2018. The committee reported the crop as fairly green and in good condition with moderate resistance (MR) to Lentil rust&Botrytis grey mold and recommended the strain to be presented for its approval.

Botanical description

Punjab Masoor-2019 is a medium seeded with spotted seed coat as people in Pakistan preferred Desi type of Masoor, high yielding and has better cooking quality variety as compared to standard variety Punjab Masoor-2009. It performs equally well both in irrigated and rainfed conditions and has vigorous growth habit even under drought condition. Its plant is semi-erect with 45-51 cm plant height as compared to Punjab Masoor-2009. Number of primary branches varies from 5-8 and secondary branches varies from 8-17 as compared to check variety depending upon the abiotic and biotic factors. Leaf color is light green with 14-16 number of leaflets. The plant has erect leaf angle with rudimentary tendril length.

Flower characteristics

Its flower size is small in size, whitish purple in color. It takes 125-130 days to mature while 50 % flowering duration is 85-90 days.

Pod characteristics

Pod size is larger than Punjab Masoor-2009 having 1.25-1.40 cm length, 5.0mm width and 0.50 cm thickness. The number of pods varies from 300-350 with 1-3 seeds per pod while pod shattering is absent. One of its unique character is that it has 4-5pods/node.

Seed characteristics

Seed color is Mottled, dot-less with ram head shape. Seed is grey in color and medium in size and larger than check variety having 3.76- 4.25 mm diameter and 2.0-2.28 mm thickness with 22-24 g 1000-seed weight.

Botanical Description

Characteristics	PUNJAB MASOOR-2019	PUNJAB MASOOR -2009
Plant traits		
Growth habit	Semi Erect	Semi erect
Plant height (cm)	45-51	35-40
Stem color	Light green	Light green
No. of primary branches	5-8	5-8
No. of secondary branches	8-17	7-15
Leaf characteristics		
Leaf color	Light Green	Green
No. of leaflets	14-16	14-15
Leaflet angle	Erect	Semi erect
Leaf Pubescence	Sparse	Sparse
Flower characteristics		
Days to flowering (50%)	85-90	85-90
Flower color	Whitish purple	Whitish purple

Flower size	Small	Small
Days to maturity	125-130	130-135
Pod characteristics		
Pod length (cm)	1.25-1.40	12.0-13.0
Pods / plant	135-210	144-240
Seeds / pod	1-3	1-2
Pods / node	Mostly 4 -5	Mostly 3
Seed characteristics		
Seed color	Mottled	Mottled
Seed shape	Lens shaped	Lens shaped
Seed size	Medium	Small to Medium
1000 seed weight (g)	22-24	20-22
Distinguishing characteristics	High yielding both under drought and normal condition, better cooking quality, longer roots, resistant to diseases and high protein%.	

Conclusions

Punjab Masoor-2019 was tested at Pulses Research Institute, AARI, Faisalabad as well as different lentil growing areas of Pakistan. It can easily be concluded that it performed better than check varieties. Its yield potential of 2529kg/ha was achieved at PRI, Faisalabad. It has high yield potential and better cooking quality. On the base of comparative productive, morphological and agronomic and special cooking characteristics, it is recommended in 51st meeting of "Punjab Seed Council" held on 14.10.2019 for all areas of Punjab.

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