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A HIGH YIELDING AND DISEASE RESISTANT MUTANT OF LENTIL DEVELOPED THROUGH SEED IRRADIATION OF AN EXOTIC GERMPLASM

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ABSTRACT

A high yielding mutant derived after seed irradiation of an exotic ICARDA (International Center for Agriculture Research in the Dry Areas) accession ILL 2580, was evaluated under the name of NL 20-9-4 for seed yield and wide adaptation in different yield trials during 1993-2006. It has shown superb yield performance in various yield trials *i.e.* yield screening nursery, intermediate, advanced and adaptation, conducted during 1993-2000 by producing 20% to 60% higher seed yield as compared to standard varieties; Masoor 85 and Masoor 93. In Lentil National uniform yield trials; NL 20-9-4 was tested at eleven locations including five locations in Punjab province of Pakistan during 2001-02 and twelve locations including five locations in Punjab during 2002-03. NL 20-9-4 ranked second by producing 1121 kg ha^{-1} during 2001-2002 and secured fourth position by producing seed yield of 1763 kg ha^{-1} during 2002-03 in the country. NL 20-9-4 showed an increase of 15% and 12% in seed yield over Masoor 93 during the year 2001-02 and 2002-03 respectively. NL 20-9-4 produced significantly the highest yield of 1983 kg ha^{-1} and 1685 kg ha^{-1} when planted on November 10, 2004 and November 22, 2005 respectively in agronomic trials. This line has shown resistance against *Ascochyta* blight, rust, and Botrytis. It has distinctness of thick stem with profuse pubescence, erect growth habit, dark green leaf, synchronous pod maturity and higher number of pods. Based on high seed yield potential along with other desirable traits, NL 20-9-4 has been approved with the name of "NIAB MASOOR 2006'' for general cultivation in the lentil growing areas of the Punjab province. Its release is expected to increase lentil production and will curtail import bill of the country.

Keywords: Seed irradiation, exotic germplasm, lentil, mutant, high yielding, disease resistant.

INTRODUCTION

Lentil is an important traditional winter pulse crop in the world having about 25% protein. In cereal-based diet of common man in Pakistan, it plays an important role to meet the protein requirements. It is planted on an area of 43.4 thousand hectares with an annual production of 25.9 thousand tonnes having an average seed yield of 597 kg ha^{-1} which is significantly low as compared to the other lentil growing countries of the world having similar acreage (Anon, 2005a). The low seed yield may partially be attributed to meager genetic diversity in lentil germplasm for desirable seed yield traits (Malik and Malik, 1988). Punjab contributes 67% in respect of area as well as production of the country. Its cultivation is mainly concentrated in the districts of Narowal, Sialkot, Jhelum, Rawalpindi, Chakwal and Gujrat (Anon, 2005b). Lentil acreage has reduced significantly to 28.0 thousand hectares during the previous one decade, which was 43.9 thousand hectares during 1995-96. In this period, the area and production decreased by 36 and 24% respectively which may partly be attributed to the non-suitability of existing lentil germplasm to this particular ecological niche and the cultivation of one variety in this growing environment will prove risky (Sadiq *et al*., 2004).

Nuclear Institute for Agriculture and Biology, Faisalabad has been engaged in lentil improvement through conventional breeding and induced mutations techniques. Intraspecific hybridization has resulted in the development of MASOOR 2002, a short duration variety suitable for growing in cotton based cropping system and for late planting (Sadiq *et al*., 2003). Whereas, a series of improved mutant lines of lentil with high seed yield potential and resistance against biotic and abiotic stresses developed through induced mutations are in hand. Out of these, an elite line i.e. NL 20-9-4 has shown superb yield performance in different yield trials.

MATERIALS AND METHODS

High Yielding Elite Line Nursery from ICARDA, Syria was planted at NIAB, Faisalabad during 1985-86 to evaluate seed yield potential. The accession ILL 2580 produced high seed yield (in the absence of diseases in the field), and has spreading growth habit with tendrils, and reddish seed coat color.

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Table 1. Seed yield performance of NL 20-9-4 in different Yield Trials.

Trial	Year	Mean Seed yield (Kg ha^{-1})				% Increase/decrease over			Rank
		*NL 20-9-4	ILL 2580 (Parent)	Masoor 85	Masoor 93	ILL 2580	Masoor 85	Masoor 93	
Yield Screening Nursery (15 entries)	1992-93	1643^{A}	1295 ^{E}	1177 ^{F}	-	27	40	-	1st
Intermediate Yield Trial (15 entries)	1993-94	2009^{A}	1653DE	1259 ^{I}	-	21	60	-	1st
Advanced Yield Trial (12 entries)	1994-95	1647^{A}	997 ^{D}	867 ^{H}	-	65	90	-	1st
Adaptations yield trials** (8 entries)	1997-98	* *	- -	- -	* *	- -	- -		
ARS, Sheikhupura		1799a	-	-	959 g	-	-	87	
Adap. Farm.Gujranwala		1306a	-	-	1118 e	-	-	17	
ARS, Pasroor		1114a	-	-	1125de	-	-	-1	
ARS, Sahowali		1083e	-	-	1153 a	-	-	-6	
NIAB, Faisalabad		1750a			1800 a			-3	
Mean		1410	- -	- -	1231	- -	- -	15	1st
NIAB, Faisalabad	1998-99	2118 ^{C}	-	-	2454 ^{A}	-	-	-15	
A.R.S Narowal		1870 ^{A}	-	-	1348 ^{C}	-	-	38	
ARS, Siailkot		601 $^{N.S}$	-	-	597 $^{N.S}$	-	-	1	
PRSS, Sahowali		1744 ^{A}			1561^{C}			12	
Mean		1583	- -	- -	1490	- -	- -	6	2 nd
NIAB, Faisalabad			- -	- -		- -	- -		
A.R.S Sheikhupura	1999-00	2069^{A}	-	-	1740^{E}	-	-	19	
PRSS, Sahowali		1639$^{N.S}$	-	-	1621^{NS}	-	-	1	
ARS, Narowal		1802 ^{A}	-	-	1509 ^{D}	-	-	20	
Mean		1545 ^{A}			1070^{BC}			44	
		1764			1485			19	1st
Over all Mean		1586			1402			13	

** Data of other entries is not shown *Approved by Punjab Seed Council as NIAB MASOOR 2006.

To induce desirable genetic variability for seed yield, yield related traits and disease resistance, the seed of ILL 2580 was treated with 200 Gy gamma rays from ^{60}Co source (Sharma and Kant, 1975; Tripathy and Dubey, 1992). M_1 generation was raised during 1986-87 and at maturity; all the surviving plants were individually harvested/threshed in each treatment. To raise M_2 generation, individual plants were grown in single row of 5m length with row-to-row distance of 0.25m during 1987-88. Based on desirable morph-physiological traits, (Solanki and Sharma, 1999) selections were made from M_2 mutated population. Single plant progenies were raised from the selected M_2 plants as M_3 during 1988-89 for their evaluation/confirmation of their true to type behavior and resistance against diseases. Susceptible checks i.e. ILL 4401 (for rust), ILL 6301 (for wilt), JL 171 (for *Ascochyta* blight), and AARIL-505 (for botrytis) were grown after every 10th rows to create natural epiphytotic environment in all the segregating generations for field screening (Nene *et al.,* 1975; Agrawal *et al.*, 1976; Pandey *et al.*, 1983; Mishra *et al.,* 1985; Ahmad and Morrall, 1996). These selections remained under evaluation for desirable agronomic traits during 1988-92 in the succeeding generations.

True breeding lines/mutants of lentil were screened under tunnel condition at Pulses Research Institute AARI, Faisalabad during fours years (2000-01, 2001-02, 2004-05 and 2005-06). Each test entry was planted in one m. long and 0.3m apart rows. Highly susceptible check 94548 was planted as spreader after every two test entries. Diseases were produced artificially in the tunnel by spraying spore suspension (30000 spores/ml) of blight and rust at three days interval till the initiation of diseases. The temperature in the tunnel was maintained at 20 + 2 C^{o} and humidity at more than 80%, being congenial for disease development. Disease severity was recorded on scale; 1 with no visible lesion and 9 with complete death of the plant. The entries rated 1-3, were considered resistant, 5 moderate and those rated 7-9 were considered susceptible. Accordingly susceptible variety had more than 10% bud infection, more than 40% foliar infection on all branches with lesions, more than 40% of the branches girdled and leaf lesions with large number of pycnidia (Mishra *et al.*, 1985).

Selection for desirable mutants continued in M_4 and M_5 generations of ILL 2580 during the years 1989-1990 and 1990-1991. The progenies of M_5 selected plant were grown during 1991-1992 and true to type progenies were

Table 2. Seed yield (Kg ha $^{-1}$) of different genotypes in Lentil NUYT during 2001-2003.

Genotype	Seed yield (2001-2002)	Genotype	Seed yield (2002-2003)
DL-3	1127 A	NARC-02-2	2117 A
NL 20-9-4*	1121 A	95511	1833 AB
93 L 055	1090 AB	KTM 1	1764 BC
NL 20-39	1065 AB	NL 20-9-4*	1763 BC
95511	1063 AB	94550	1688 BC
DL-1	1049 AB	AEL 49/20/91	1679 BC
Markaz 2000	1038 AB	98505	1664 BC
NL 20-27-2	1034 AB	NL 768-2-1	1659 BC
NL 20-11-1	1031 AB	DL-1	1653 BC
94550	1015 AB	NARC-02-1	1633 BC
94517	1009 AB	NL 20-27-2	1631 BC
EL 49/20	1002 AB	93 L 055	1597 BC
94505	935 AB	Masoor 93	1582 BC
Masoor 93	925 AB	NL 20-39	1578 BC
93 L 026	910 AB	AEL 23/40/91	1576 BC
TCM 85	848 AB	DL-3	1554 BC
NL 20-768-2-1	794 BC	98 CL-008	1546 BC
ILL-8076	549 CD	95520	1516 BC
ILL-8081	529 D	NARC-02-3	1474 BC
		99 CL-007	1435 CD
		DL-5	1152 D
		ILL-8081	628 E
		ILL-8076	611 E

*Approved by Punjab Seed Council as NIAB MASOOR 2006.

bulked. To evaluate their yield potential, different sets of trials; yield screening nursery (1992-1993), intermediate yield trial (1993-94), advanced yield trial (1994 -1995), adaptation trials (1997-2000) and National Uniform Yield trials (2001-2003) were laid out by following appropriate experimental design along with recommended agronomic practices. Lentil National Uniform Yield Trials (LNUYT) were organized in Pakistan by National Coordinator (Pulses) NARC, Islamabad in which different research organizations working on lentil contributed elite lines for testing their seed yield potential. During 2001-2002, NIAB contributed NL 20-9-4, NL 20-27-2 NL 768-2-1, NL 20-39, NL 20-11-1 and TCM 85, Pulses Research Institute AARI, Faisalabad; 94505, 94517, 94550, 95511 and Masoor 93, NARC; Markaz 2000, Arid Zone Research Institute, Bhakhar; 93 L 026, 93 L 055, AZRC Quetta; ILL 8076 and ILL 8081, ARI D.I. Khan; DL-1 and DL-3 and NIA Tandojam; AEL 49/20. During 2002-2003, NIAB contributed NL 20-9-4, NL 20-27-2, NL 768-2-1 and NL 20-39, Pulses Research Institute AARI, Faisalabad; 94550, 95511, 95520, 98505 & Masoor 93, ARI D.I. Khan; DL-1, DL-3 and DL-5, NARC, Islamabad; NARC-02-1, NARC-02-2 and NARC-02-3, NIA Tandojam; AEL 23/49/91 & 49/20/91, AZRC, Quetta; ILL 8076 and ILL 8081, BARI, Chakwal; 98CL-008 and 98CL-007, AZRI, Bhakhar; 93L 055, and BARS, Kohat; KTM-1. Masoor 93 and Markaz 2000 were used as standard varieties. To determine optimum sowing time to realize yield potential, sowing date trials were conducted during 2004 -05 and 2005-06 at NIAB, Faisalabad. Data on seed yield and yield related traits were recorded and statistically analysed (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

A. Seed yield

Seed yield performance of NL 20-9-4 in comparison with standard varieties/parent-ILL 2580 in different yield trials; yield screening nursery, intermediate and advanced is shown in Table 1. NL 20-9-4 produced significantly the highest seed yield of 1643 kg ha^{-1}, 2009 kg ha $^{-1}$ and 1647 kg ha $^{-1}$ respectively as compared to the seed yield of parent ILL 2580 and standard variety Masoor 85. In adaptation yield trial, NL 20-9-4 produced significantly the highest yield of 1410 kg. ha^{-1} in 1997-98, 1583 kg ha^{-1} in 1998-99 kg. ha^{-1} and 1764 kg ha^{-1} in 1999-2000. On overall mean basis NL 20-9-4 showed 13% increase in seed yield over Masoor 93 and secured first position in 1997-1998, & 1999-2000 and second position during the year 1998-1999.

Non-significant differences for highest seed yield were observed between DL-3 and NL 20-9-4 to TCM 85 and

Table 3. Seed yield (Kg ha^{-1}) of NL 20-9-4 in comparison with Masoor 93 in Lentil National Uniform Yield Trials during 2001-2002 and 2002-2003.

Location	2001-2002			2002-2003		
	NL 20-9-4	Masoor 93	% Increase/ Decrease	*NL 20-9-4	Masoor 93	% Increase/ Decrease
AZRI, Bhakkar	675	1025	- 34.0	542	867	- 37.0
NIA, Tandojam	727	477	+ 52.0	2361	2375	=
AZRI, Bahawalpur	65	81	- 20.0	2083	1563	+ 33.0
AARU, Fausakabad	2708	2097	+ 29.0	2825	2976	- 5.0
ARSM, Swat	309	198	+ 56.0	1025	1296	- 21.0
BARI, Chajwak	535	694	- 23.0	1492	1484	=
AZRI, Quetta	1943	1343	+ 45.0	1984	1084	+ 84.0
ARI D. I. Khan	1618	1262	+ 28.0	2500	2222	+ 13.0
NARC, Islamabad	1768	1171	+ 51.0	2819	2075	+ 36.0
NIAB, Faisalabad	1347	1478	- 9.0	1507	1364	+ 10.0
RRI, Dhokri	632	345	+ 83.0			
BARS, Kohat				903	510	+ 77.0
ARI, Sariab				1118	1173	=
Sariab Quetta						
Average	1083	933	+ 15.0	1764	1582	+ 12.0

Table 4. Performance of NL 20-9-4 at different Sowing dates at NIAB, Faisalabad during 2004 -05.

Trait/ Variety/ Sowing date	Nov. 10, 2004			Nov. 25, 2004			Dec. 10, 2004			Dec. 25, 2004		
	Mas 2002	Mas 93	NL* 20-9-4	Mas 2002	Mas 93	NL 20-9-4	Mas 2002	Mas 93	NL 20-9-4	Mas 2002	Mas 93	NL 20-9-4
Days to flowering	66^{C}	109^{A}	105^{B}	60^{C}	101^{A}	97^{B}	59^{C}	98^{A}	93^{B}	60^{C}	95^{A}	90^{B}
Days to maturity	110^{C}	149^{A}	140^{B}	115^{C}	142^{A}	136^{B}	90^{C}	136^{A}	131^{B}	102^{C}	129^{A}	123^{B}
Plant height (cm)	43.9^{B}	46.7^{B}	57.7^{A}	42.3^{B}	46.1^{A}	47.5^{A}	40.1^{AB}	42.6^{A}	37.3^{B}	37.3^{A}	34.9^{AB}	33.6^{B}
P. Branches/plant	2.4^{B}	2.9^{A}	2.9^{A}	2.1B	2.7^{A}	2.5^{A}	2.0^{B}	2.7^{A}	2.7^{A}	2.1^{B}	2.5^{A}	2.3A^{B}
Pods/plant	234^{C}	269^{B}	344^{A}	222^{B}	247^{B}	282^{A}	156^{AB}	146^{B}	180^{A}	150^{AB}	132^{B}	178^{A}
Pod length	1.13^{A}	1.03^{C}	1.10^{B}	1.13^{A}	1.05^{B}	1.06^{C}	1.11^{A}	1.07^{B}	1.07^{C}	1.11^{A}	1.03^{C}	1.06^{B}
Seeds/pod	2.0^{A}	1.70^{B}	2.0^{A}	2.0^{A}	1.7^{B}	1.9^{A}	2.0^{A}	1.7^{B}	1.7^{B}	2.0^{A}	1.6^{B}	1.7^{B}
1000 seed weight	23.2^{A}	22.2^{B}	21.7^{B}	22.4^{B}	24.4^{A}	21.7^{B}	23.5^{B}	24.0^{A}	21.7^{B}	23.7^{A}	24.2^{A}	21.8^{B}
Biom. Yield (kg ha^{-1})	4715^{C}	6379^{B}	7280^{A}	4776^{C}	5616^{B}	6517^{A}	3924^{C}	4507^{B}	4997^{A}	2981^{B}	2704^{B}	4090^{A}
Harvest Index (%)	35^{A}	27^{C}	28^{B}	31^{A}	27^{A}	29^{A}	36^{A}	16^{C}	30^{B}	47^{A}	25^{C}	35^{B}
Seed Yield (kg ha^{-1})	1636^{B}	1352^{C}	1983^{A}	1407^{B}	1498^{B}	1885^{A}	1407^{A}	721^{B}	1525^{A}	1421^{A}	679^{B}	1421^{A}
Date of sowing	1657^{A}			1596^{A}			1218^{B}			1174^{B}		

the lowest between ILL 8076 and ILL 8081 in Lentil NUYT during 2001-02 (Table 2). NARC– 02-2 and 95511 showed non-significant differences for seed yield during 2002-2003. However 95511, KTM-1, NL 20-9-4, 94550 to NARC-02-3 showed non-significant differences in seed yield. The lowest seed yield was observed between ILL 8081 and ILL 8076. NL 20-9-4 exhibited 15% and 12% increase over Masoor 93 in seed yield on mean basis during the year 2001-2002 and 2002-2003 respectively (Table 3).

Non-significant differences in seed yield were recorded between the sowing of November 10 and November 25 and December 10 & December 25 (Table 4). NL 20-9-4 produced significantly the highest seed yield of 1983 kg ha^{-1} when planted on November 10, 2004. Number of pods per plant and biomass yield contributed for this high seed yield. Non-significant differences in high seed yield were observed between November 12 and November 22 sowing and significantly the lowest yield was produced by December 12 planting (Table 5). NL 20-9-4 produced significantly the highest seed yield of 1685 kg ha^{-1} when planted on November 22, 2005. Number of pods and biomass yield were the yield contributing factors. These results indicated that November 10-25 is the optimum-sowing time for getting the highest seed yield.

B. Disease resistance

NL 20-9-4 exhibited desirable level of resistance to Ascochyta blight, whereas susceptible variety 94548 (spreader) has shown high degree of susceptibility during the four years. Other elite lines also showed similar disease resistance reaction (Table 6). As regard to rust and Botrytis, NL 20-9-4 showed resistance response (Table 7). Masoor 85 and Masoor 93 also showed resistance reaction to rust and BGM. MASOOR 2002 showed highly resistant reaction to these diseases (Table 7). Susceptible check 94548 showed highly susceptible reaction.

Table 5. Performance of NL 20-9-4 at different Sowing dates at NIAB, Faisalabad during 2005-06.

Trait/ Variety/ Sowing date	Nov. 12, 2005			Nov. 22, 2005			Dec. 2, 2005			Dec. 12, 2005		
	Mas 2002	Mas 93	NL* 20-9-4	Mas 2002	Mas 93	NL 20-9-4	Mas 2002	Mas 93	NL 20-9-4	Mas 2002	Mas 93	NL 20-9-4
Days to flowering	60^{E}	106^{A}	105^{A}	55^{F}	98^{B}	97^{B}	55^{F}	98^{B}	97^{B}	60^{E}	94^{C}	92^{D}
Days to maturity	108^{H}	145^{A}	140^{BC}	113^{G}	139^{B}	141^{C}	86^{I}	132^{D}	132^{D}	109^{H}	127^{E}	124^{F}
Plant height (cm)	36.3^{CD}	41.8^{A}	40.4^{AB}	38.3^{BC}	42.7^{A}	38.5^{BC}	33.3^{EF}	40.9^{A}	34.6^{DE}	32.0^{F}	34.7^{DE}	29.7^{G}
P. Branches/plant	1.7^{E}	2.3^{AB}	2.0^{BCDE}	1.3^{F}	2.3^{ABC}	2.5^{A}	1.13^{F}	2.07^{BCD}	1.93^{CDE}	1.2^{F}	2.0^{BCDE}	1.8^{D}
Pods/plant	68^{F}	159^{C}	184^{B}	63^{F}	180^{B}	227^{A}	37^{G}	103^{E}	157^{C}	36^{G}	113^{E}	137^{D}
Pod length	1.04^{B}	1.00^{D}	1.01^{CD}	1.07^{A}	1.00^{D}	1.00^{D}	1.07^{A}	1.01^{G}	1.00^{D}	1.03^{BC}	1.00^{D}	1.00^{D}
Seeds/pod	2.0^{A}	1.7^{B}	2.0^{A}	2.0^{A}	1.4^{C}	2.0^{A}	2.00^{A}	1.40^{C}	1.93^{A}	1.9^{AB}	1.3^{C}	1.9^{AB}
1000 seed weight	25.9^{AB}	24.3^{BC}	23.9^{CD}	26.8^{A}	23.9^{CD}	23.8^{CD}	25.6^{AB}	22.9^{CD}	21.0^{EF}	24.3^{BC}	22.4^{DE}	20.8^{E}
Bio. Yield (kg ha^{-1})	1944^{FG}	4021^{B}	4437^{A}	2427^{DE}	4645^{A}	3883^{B}	2357^{DE}	3953^{B}	3189^{C}	1656^{G}	2691^{D}	2247^{EF}
Harvest Index (%)	50.6^{A}	31.9^{D}	39.3^{C}	48.0^{AB}	30.9^{D}	41.0^{C}	45.0^{BC}	28.8^{D}	40.6^{C}	32.3^{D}	22.1^{E}	29.4^{D}
Seed Yield (kg ha^{-1})	985^{D}	1283^{BC}	1671^{A}	1165^{CD}	1359^{B}	1685^{A}	1060^{D}	1283^{BC}	1293^{BC}	531^{E}	614^{E}	657^{E}
Date of sowing	1313^{A}			1403^{A}			1212^{B}			601^{C}		

Table 6. Screening of NIAB Lentil Elite Lines against *Ascochyta lentis* under artificial epiphytotic environment (Tunnel) at Pulses Research Institute, Faisalabad.

S. No.	Genotype	2000-01	2001-02	2004 -05	2005-06
1	NL 20-9-4*	3	3	3	3
2	NL 20-11-1	5	3	-	3
3	NL 20-27-2	5	3	-	5
4	NL 20-39	3	3	-	3
5	NL 768-2-1	5	3	-	3
6	94548 (Spreader)	7	7	9	9

Table 7. Screening of NIAB Lentil Elite Lines against *Uromyces fabae* and *Botrytis cinerea* Under Tunnel Conditions during 2005-06 at Pulses Research Institute AARI, Faisalabad.

Sr. No.	Genotype	BGM	Rust
1	NL 20-9-4*	3	1
2	NL 56-1	3	1
3	Masoor 85	3	3
4	Masoor 93	1	1
5	Masoor 2002	1	1
6	94548 (Spreader)	9	7

Disease Scoring

Disease reaction	Disease Score	Disease reaction	Disease Score
Highly resistant	1	Susceptible	6-7
Resistant	2-3	Highly susceptible	8-9

Genetic variability is one of the important pre-requisites for advancement of crop breeding program. The magnitude of genetic variability existing in lentil germplasm and generated through mutation breeding had earlier been reported (Dixit and Dubey, 1986; Sarkar and Sharma 1988, Badiya *et al.*, 1988; Ramgiry *et al.*, 1989). In the present investigation, mutation has resulted in an increase in variance in quantitative characters, which has been utilized by selection. The larger response to selection for seed coat colour, number of pods, lodging resistance, biomass yield and seed yield was achieved. Economically important mutations were induced earlier (Sharma and Sharma 1977, 1979). One of the major factor to low production in lentil is vulnerability to diseases i.e.

lentil blight, rust and botrytis. These biological stresses cause appreciable yield losses. Induced mutant variety NIAB MASOOR 2006 has shown field resistance under natural conditions, which was confirmed by artificially inducing epiphytotic environment (under tunnel). Similar results for induction of disease resistance were earlier reported (Haq *et al.*, 2002).

In sequel, mutation breeding has played a significant role in augmenting the existing genetic variability in lentil. A series of mutants with desirable traits has been developed. Out of this one mutant NL 20-9-4 with the name of NIAB MASOOR 2006 has been approved by Provincial Seed Council in its 32nd meeting held on 07-11-2006 at Lahore for general cultivation in the major lentil growing areas of the Punjab province.

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