New high-yielding kidney bean (*Phaseolus vulgaris* L.) variety 'NIFA Lobia-25'

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Abstract

Twenty-five genotypes as germplasm were collected from different sources within the country and field-evaluated at the Nuclear Institute for Food & Agriculture (NIFA), Peshawar, for plant type and yield, and related traits in non-replicated trials during 2019 and 2020. Based on an initial evaluation, nine genotypes (NKB-Kenya, NKB-RKBJ-269-Uganda, NCB-Kuram local, NCB-Afghani, NCB-China Bean, NKB-RKB-423-Ukraine, NKB-ERKBJ-470-Ethiopia, NKB-RKB-Argentine, and NKB-RKB-Ethiopia) were identified and selected for further evaluation in replicated yield trials in 2021 and 2022, as well as on kidney bean growers' fields in Kurram in 2023 and 2024. In the replicated yield trials conducted at NIFA, the candidate genotype 'NKB-Kenya (NIFA Lobia-25) performed better for grain yield (2,086 kg/ha) as compared to the check variety NIFA Lobia Red-22 (1,836 kg/ha). In the yield trials conducted at Kurram, NKB-Kenya (NIFA Lobia-25) out-yielded (2,044 kg/ha) the standard check (1,867 kg/ha). NKB-Kenya (NIFA Lobia-25) exhibited an average 11.6% yield increase over the check variety. Based on its better performance for yield and other agronomic traits, Khyber Pakhtunkhwa (KP) Seed Council approved NIFA Lobia-25 for commercial cultivation in Kurram in particular and other kidney bean growing areas of KP in general.

Introduction

Kidney bean (*Phaseolus vulgaris* L.) is a notable food legume crop consumed in substantial quantities in Pakistan, including the KP province. Kidney bean is known for its supportive nature for health, packed with different nutritional constituents (Shevkani et al., 2022; Palupi et al., 2023; Srenuja et al., 2023; Kong et al., 2024; Mujtaba et al., 2025; Zahid et al., 2025). Despite its huge annual consumption in Pakistan (roughly estimated to be 50,000 tons), its area under cultivation and total annual production have not so far been reported in any official federal and provincial agricultural statistics documents.

So far, nine kidney bean commercial varieties, including NIFA Lobia-25 with semi-erect and climbing growth habits, have been released in the country. All of these varieties have been released by the KP Agricultural Research System and NIFA, Peshawar. These varieties are adapted to different agro-ecological zones of the province. Agricultural Research Station (ARS), Baffa, Mansehra, is the pioneer research center that released the first kidney bean variety, Himalya-1, in Pakistan. This variety was recommended for cultivation in the Hazara Division of the KP. Four varieties, namely Swat Red, Green Hills, Gorilla, and Black Queen, were developed by the Agricultural Research Institute (ARI), Mingora, Swat, whereas three varieties, namely NIFA Lobia Red-22, NIFA Lobia Yellow-22

(Khattak et al*.,* 2023), and NIFA Lobia-25 have been developed by NIFA, Peshawar.

NIFA Lobia-25 will play a positive role in increasing the overall productivity of this crop in Kurram, in particular, and other kidney bean-growing areas in general. The current manuscript discusses the development of a new kidney bean variety, NIFA Lobia-25. Its performance was assessed under field conditions in comparison with several other known varieties.

Materials and Methods

Twenty-five diverse accessions of local and exotic origin were collected from different sources within the country. Initial grading of seeds of each genotype was carried out based on seed color and size. Uniformly-sized seeds of each genotype were sown in the field in a non-replicated fashion at NIFA, Peshawar, in 2019 and 2020 for confirmation of seed color and growth habit. Each genotype was planted in four rows of 4 m length with row-to-row and plant-to-plant distances of 45 cm and 15 cm, respectively.

Based on performance in a non-replicated trial, a total of nine genotypes were selected for evaluation for yield and related attributes in replicated yield trials at NIFA as well as on farmers' fields at different locations in Kurram. All trials were planted in a Randomized Complete Block Design. Each genotype was sown in four rows of 4 m length with 45 cm and 20 cm row-to-row and plant-to-plant spaces, respectively. Each genotype was replicated three times. Irrigation was applied when needed across the entire crop growth season.

Data for yield traits were recorded in each genotype in each replication. All statistical analyses were performed according to Steel and Torri (1980).

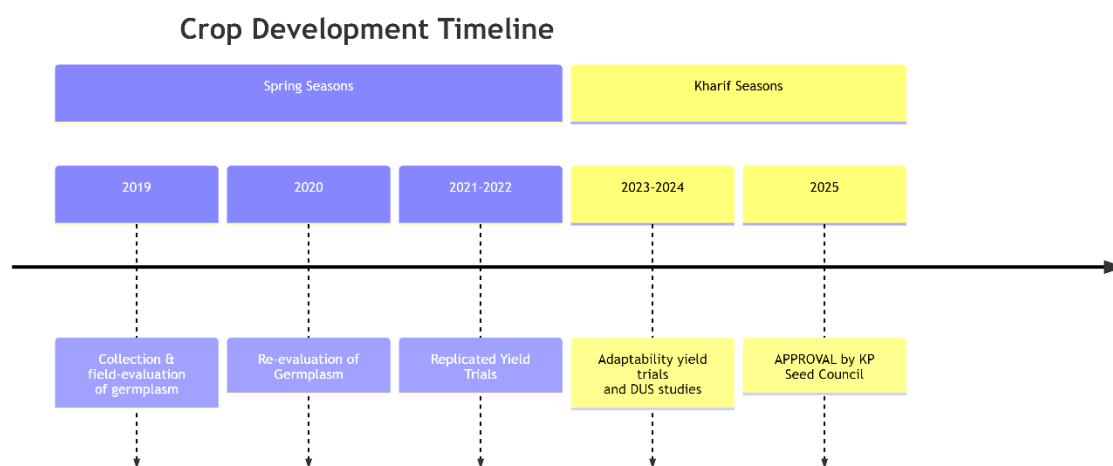The development history of NIFA Lobia-25 is presented in Figure 1.

Figure 1: The development history of NKB-Kenya (NIFA Lobia-25)

Results and Discussion

The results of the replicated trials are presented in **Tables 1 to 4**. In a yield trial conducted at NIFA, Peshawar, in the Spring 2021 season, NKB-Kenya (NIFA Lobia-25) produced significantly ($p \leq 0.05$) higher seed yield (2,098 kg/ha) than 1,788 kg/ha produced by the check variety Himalya-1 (**Table 1**), with a 17.3% increase in yield over the check variety. Similarly, in spring 2022, NKB-Kenya (NIFA Lobia-25) produced a higher seed yield of 2,077 kg/ha compared with the 1,883 kg/ha yield produced by the check variety NIFA Lobia Red-22, surpassing the check variety's yield by 10.3% (**Table 2**). In the replicated yield trial sown on farmers' fields at five locations in Kurram during Kharif 2023, NKB-Kenya (NIFA Lobia-25) produced a higher average seed yield of 2026 kg/ha compared with the average seed yield of 1,847 kg/ha produced by the check variety NIFA Lobia Red-22 (**Table 3**). In a replicated yield trial conducted on the same locations in Kharif 2024, NKB-Kenya (NIFA Lobia-25) also out-yielded the check variety by producing an average seed yield of 2,061 kg/ha against an average seed yield of 1,886 kg/ha produced by NIFA Lobia Red-22, with a 9.2% increase in seed yield over the check variety (**Table 4**).

Table 1: Performance of NKB-Kenya in a preliminary yield trial conducted at NIFA, Peshawar, in spring 2021

S. #	Genotype	HSW (g)	SY (kg/ha)	% increase over check variety
1	NKB-Kenya	46	2098	17.3
2	NKB-RKBJ-269-Uganda	40	1681	-
3	NKB-RKB-Ethiopia	22	1141	-
4	NKB-RKB-423-Ukraine	21	1541	-
5	NKB-ERKBJ-470-Ethiopia	23	1329	-
6	NKB -RKB-Argentine	23	1381	-
7	NKB-Afghani	47	975	-
8	NKB-Kuram Local	22	1728	-
9	NKB-China Bean	19	625	-
11	Himalaya-1 (Check)	33	1788	-
CV (%)		1.41	7.99	-
LSD (0.05)		1.39	165.33	-

HSW: 100-Seed weight; SY: Seed yield

Table 2: Performance of NKB-Kenya (NIFA Lobia-25) in a preliminary yield trial conducted at NIFA, Peshawar, in spring 2022

S. #	Genotype	HSW (g)	SY (kg/ha)	% increase over check variety
1	NKB-Kenya	35	2077	10.3
2	NKB-RKBJ-269-Uganda	26	1599	-
3	NKB-RKB-Ethiopia	33	1130	-
4	NKB-RKB-423-Ukraine	19	977	-
5	NKB-ERKBJ-470-Ethiopia	35	1311	-
6	NKB -RKB-Argentine	24	1363	-
7	NKB-Afghani	18	1573	-
8	NKB-Kuram Local	21	1761	-
9	NKB-China Bean	36	1498	-
10	NIFA Lobia Red-22 (Check)	44	1883	-
11	NIFA Lobia Yellow-22 (Check)	23	1745	-
CV (%)		1.64	7.22	-
LSD (0.05)		3.38	124.89	-

HSW: 100-Seed weight; SY: Seed yield

The kidney bean improvement program is at the initial stages in Pakistan, with potential areas lying in the KP province. There are only ten approved varieties available so far, which are not sufficient to bring reasonable acreage under cultivation. Development of improved commercial varieties of crop plants not only plays a positive role in the establishment of a crop but also ensures yield improvement and insect/pest resistance, provides a strong genetic base to withstand biotic and abiotic stress conditions, enhances different agronomic traits, and eventually improves quality and market potential (Katuuramu et al., 2018; Hafeez et al., 2023; Ajmal et al., 2024; Limenie and Alehegn, 2025). NIFA Lobia-25 showed an average increase of 11.6% in seed yield over the check varieties in on-station and across-locations yield trials (**Tables 1 to 4**) and is therefore expected to contribute positively in enhancing the overall productivity of kidney bean in the KP province, in particular, and the country in general.

Table 3: Performance of NKB-Kenya (NIFA Lobia-25) in an adaptability yield trial on five different farmers' fields in Kuram in kharif 2023 (Av. % increase over check: 9.6)

Genotype	Seed yield (kg ha^{-1})					
	Malana	Boshara	Shoblan	Shlozan	Kachkina	Av.
NKB-Kenya	2061	2012	1983	2053	2023	2026
NKB-RKBJ-269-Uganda	1478	1441	1541	1641	1701	1560.4
NKB-RKB-Ethiopia	1245	1252	1311	1403	1491	1340.4
NKB-RKB-423-Ukraine	1030	1012	1057	1123	1200	1084.4
NKB-ERKBJ-470-Ethiopia	1356	1373	1299	1332	1388	1349.6
NKB -RKB-Argentine	1299	1322	1333	1360	1410	1344.8
NKB-Afghani	1683	1648	1653	1691	1711	1677.2
NKB-China bean	1641	1599	1583	1626	1721	1634
NKB-Kuram local	1811	1788	1755	1794	1803	1790.2
NIFA Lobia Red-22 (Check)	1879	1835	1810	1863	1848	1847

Table 4: Performance of NKB-Kenya (NIFA Lobia-25) in an adaptability yield trial on five different farmers' fields in Kuram in kharif 2024 (Av % increase over the best check: 9.2)

S. #	Genotype	Seed yield (kg ha^{-1})					
		Malana	Boshara	Shoblan	Shlozan	Kachkina	Av.
1	NKB-Kenya	2072	2041	2051	2083	2059	2061
2	NKB-RKBJ-269-Uganda	1479	1441	1577	1681	1699	1575
3	NKB-RKB-Ethiopia	1253	1233	1343	1437	1501	1353
4	NKB-RKB-423-Ukraine	1100	1064	1111	1099	1134	1101
5	NKB-ERKBJ-470-Ethiopia	1399	1413	1325	1315	1346	1360
6	NKB-RKB-Argentine	1325	1352	1371	1336	1369	1351
7	NKB-Afghani	1637	1687	1698	1707	1688	1683
8	NKB-China bean	1688	1643	1595	1641	1667	1647
9	NKB-Kuram local	1791	1752	1792	1771	1763	1774
10	NIFA Lobia Red-22 (Check)	1901	1865	1921	1887	1854	1886
11	NIFA Lobia Yellow-22 (Check)	1667	1631	1599	1617	1649	1633
CV (%)		5.7	5.2	4.5	4.4	5.4	-
LSD (5%)		157.4	169.3	147.1	151.2	163.1	-

The success of improved commercial crop varieties depends on their ready adoption by respective growers. This process plays a transformative role in strengthening the socio-economic conditions of subsistence growers. This results in shifting growers' attention from ensuring domestic food security to healthy competition in the market. This will generate extra economic gains through increased farm production, resilience and risk minimization, tolerance to environmental abnormalities, commercialization, and socio-economic gains (Mbugua et al., 2021; Khattak et al., 2023; Xie et al., 2023).

Based on enhanced genetic yield potential and adaptability to local growing conditions, the adoption of NIFA Lobia-25 by local kidney bean growers will play a positive role in ensuring domestic food security, as well as handsome market gains, thereby improving the overall socio-economic condition of the subsistence growers.

Author(s), Editor(s) and Publisher's declarations

Contribution of authors
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Permissions and ethical compliance
This study does not involve human/animal subjects, and thus no ethical approval is required.

Handling of bio-hazardous materials
The authors certify that all experimental materials were handled with great care during collection and experimental procedures. After completion of the study, all materials were properly discarded to minimize/eliminate any types of bio-contamination(s).

Supplementary material
No supplementary material is included with this manuscript.

Conflict of interest
The authors declare no conflict of interest.

Availability of primary data and materials
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