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# 'NIFA Mung-25': A newly developed high-yielding mungbean [*Vigna radiata* (L.) Wilczek] variety with improved resistance to major diseases

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**Abstract**

An exotic mungbean genotype 'V2802' acquired from the World Vegetable Center (WVC) was hybridized with the Mungbean Yellow Mosaic Virus (MYMV) tolerant variety 'Ramzan' in spring 2012 at the Nuclear Institute for Food & Agriculture (NIFA), Peshawar, Pakistan. The $F_1$ generation was raised in spring 2013, whereas $F_2$-$F_6$ populations were planted during the Kharif (Summer to Monsoon) seasons 2013-2017. Single plants/progenies' selections were based on specific criteria, i.e., green seed color, better plant type, higher grain yield, and MYMV tolerance. A best-performing progeny, NFM-103-30 (NIFA Mung-25), was selected and evaluated in replicated yield trials at NIFA, various locations in Khyber Pakhtunkhwa (KP), and in the National Uniform Yield Trials (NUYTs) across Pakistan during 2018–2023. At NIFA and other locations of the Khyber Pakhtunkhwa (KP) province, NFM-103-30 (NIFA Mung-25) outperformed the check varieties, producing the highest average yield of 2,062 kg ha$^{-1}$ compared to the check varieties Ramzan (1,768 kg ha$^{-1}$), AZRI Mung-18 (1,698 kg ha$^{-1}$), and NIFA Mung-19 (1,757 kg ha$^{-1}$), with an average yield increase of 23.2%. In NUYTs conducted in 2022, NFM-103-30 (NIFA Mung-25) produced the highest mean yield of 1,323 kg ha$^{-1}$ against the national check variety AZRI Mung Jumbo (1,267 kg ha$^{-1}$) across KP. Similarly, during evaluation in NUYT-2023, NFM-103-30 (NIFA Mung-25) produced a grain yield of 1,207 kg ha$^{-1}$, out-yielding the check variety NIAB Mung-2021 (1,010 kg ha$^{-1}$). The candidate genotype/line also showed resistance to MYMV under field conditions. Based on its excellent performance in terms of grain yield across KP, the KP Seed Council approved NIFA Mung-25 as a new commercial mungbean variety for general cultivation in KP on August 6, 2025.

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## Introduction

Mungbean is a vital warm-season legume crop cultivated on reasonable acreage in Pakistan, including Khyber Pakhtunkhwa (KP) province, both in irrigated and rainfed areas. In the year 2023-24, mungbean was planted on an area of 0.201 million hectares with a total production of 153.7 thousand tonnes (Agriculture Management Information System, 2024). Despite its importance as an edible legume, its average national yield is far below that of neighboring countries. One of the underlying reasons for the low average national yield is the shortage of improved commercial varieties adapted to local growth conditions (Ullah et al., 2025). Therefore, to enhance the overall productivity of mungbean in the country, development of more high-yielding commercial varieties is of utmost importance, as development and adoption of new improved varieties is an indicator of the effectiveness of an agricultural research system (Witcombe et al., 2016; Pepjin et al., 2019; Khattak et al., 2021, 2022, 2023).

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Conventional plant breeding is still considered an efficient tool to gather genetic variability for yield or any other trait of interest from different genotypes of mungbean and other crop plants into a single variety through hybridization (Buzdar et al., 2025). It has significantly contributed to enhancing the overall productivity of crop plants. Around the globe, conventional plant breeding has resulted in the development of many new commercial varieties in various crop plants having favorable traits of economic importance (Jayashree et al., 2013; Singh et al., 2003; Gupta et al., 2015; Singh et al., 2018; Pratap et al., 2019; Singh et al., 2020; Rekha et al., 2025).

Nuclear Institute for Food & Agriculture (NIFA) is actively engaged in the improvement of mungbean through developing high-yielding green and black-seeded varieties. The institute has so far evolved three commercial green-seeded and two black-seeded varieties, which are being successfully grown in Kurram and other mungbean growing areas of the KP. In this backdrop, the NIFA scientists felt it necessary to develop high-yielding mungbean varieties that must excel the contemporary varieties. Thus, this manuscript discusses the development of a new high-yielding green-seeded mungbean variety 'NIFA Mung-25' using classical plant breeding protocols.

## Materials and Methods

An exotic genotype "V2802" acquired from the Asian Regional Center-Asian Vegetable Research Development Center (ARC-AVRDC), now the World Vegetable Center, Taiwan, was hybridized with a Mungbean Yellow Mosaic Virus (MYMV) resistant mungbean commercial variety "Ramzan" as a single cross-combination (V2802 × Ramzan) at the Nuclear Institute for Food and Agriculture (NIFA), Peshawar, in spring 2012, following the procedure outlined elsewhere (Khattak et al., 1998). The $F_1$ generation was raised from crossed pods in spring 2013. All recombinant plants were picked, threshed, and bagged individually. The $F_2$ population, along with both parents, was planted in Kharif 2013. The MYMV-susceptible genotype "VC1560D" was repeatedly planted in rows in the $F_2$ population for use as a MYMV spreader to intensify MYMV inocula from natural sources. Chemical pesticides were avoided to maintain the natural population of whitefly (*Bemisia tabaci*). Single plants were selected for high yield (more pods per plant), semi-erect growth habit, more productive branches, and MYMV resistance. The $F_4$-$F_6$ generations were raised for generation advancement and confirmation of breeding behavior/genetic stability of the desired traits during 2014-2017.

The selected recombinants were tested along with the check varieties in replicated trials to evaluate for seed yield and related components at NIFA and other locations in KP, in the National Uniform Yield Trials (NUYTs) across the country during 2018-2023. Each trial was planted in a Randomized Complete Block Design (RCBD) with each genotype sown in 04 rows of 04 m length. Row-to-row distance was maintained at 30 cm, and plant-to-plant space was kept at 10 cm. Each plot of each test genotype was replicated thrice. The experiments were sown under irrigated conditions, and need-based irrigation was applied. The lines were also screened for MYMV in a separate nursery at NIFA in the same seasons.

## Statistical analysis of data

Means of all parameters were computed from the data. The original raw data were processed for appropriate analysis of variance (ANOVA) for each variable following Steel and Torrie (1980).

The breeding history of NIFA Mung-25 is given below in a chronological order in Table 1.

**Table 1: Breeding history of NIFA Mung-25 (NFM-103-30)**

| Year | F. Gen./Trial | Remarks |
|---|---|---|
| 2012 | Hybridization | A single cross "V2802 × Ramzan" was attempted at NIFA |
| 2013 | $F_1$ | $F_1$ generation of the cross "V2802 × Ramzan" was raised |
| Kharif 2013 | $F_2$ | The $F_2$ population was raised. Single plant selections for traits of interest and screening for MYMV resistance |
| Kharif 2014 | $F_3$ | Raised the $F_3$ population for confirmation of breeding behavior and generation advancement. Single plant selections for traits of interest and screening for MYMV resistance were done |
| Kharif 2015-17 | $F_4$-$F_6$, and screening against MYMV | Planting of the $F_4$-$F_6$ generations to confirm the breeding behavior of the traits. Selection of true breeding with desired traits was carried out. MYMV resistance recorded |
| Kharif 2018-23 | Yield trials and screening against MYMV | Evaluation of elite lines in replicated yield trials and NUYTs, and MYMV resistance screening were done. The best line 'NFM-103-30' was evaluated for Distinctness, Uniformity, and Stability (DUS). |

## Results and Discussion

Yield performance of NIFA Mung-25 in different replicated yield trials, other locations in KP, and NUYTs is presented in Tables 2 to 11. In preliminary yield trials planted at NIFA in Kharif 2018 and 2020, NFM-103-30 (NIFA Mung-25) out-yielded the check variety Ramzan with statistically significant ($p \leq 0.05$) higher seed yield of 1,834 and 2,269 kg ha$^{-1}$, respectively, against seed yield of Ramzan (1,444 and 2,092 kg ha$^{-1}$, respectively) (Tables 2 & 3). In the advanced lines yield trial (ALYT), conducted at NIFA in Kharif 2021, NFM-103-30 (NIFA Mung-25) produced statistically significant ($p \leq 0.05$) yield of 2,361 kg ha$^{-1}$ compared with 1,760 kg ha$^{-1}$ seed yield of the check variety NIFA Mung-19 (Table 4). During the same season in adaptability yield trial conducted at the Agricultural Research Stations (ARS), Karak and Agricultural Research Institute (ARI), Dera Isamail Khan (D.I. Khan), NFM-103-30 (NIFA Mung-25) performed better and produced statistically significant higher seed yield of 1,879 and 1,845 kg ha$^{-1}$, respectively in comparison with the check variety NIFA Mung-19 (1,698 & 1,623 kg ha$^{-1}$, respectively) (Tables 5 & 6). In the advanced lines yield trial (ALYT) conducted at NIFA in Kharif 2022, NFM-103-30 (NIFA Mung-25) significantly ($p \leq 0.05$) out-yielded (2,189 kg ha$^{-1}$) the check variety NIFA Mung-19 (1,742 kg ha$^{-1}$) (Table 7). During the same season, in the adaptability yield trial planted at ARS, Karak, and ARI, D.I. Khan, NFM-103-30 (NIFA Mung-25) produced statistically significant ($p \leq 0.05$) higher seed yield of 1,879 and 1,947 kg ha$^{-1}$, respectively against the seed yield of 1,627 and 1,771 kg ha$^{-1}$, produced by the check variety NIFA Mung-19 (Tables 8 and 9). In Mungbean NUYT conducted during Kharif 2022, NFM-103-30 under code name NIFA Mung-10 (NIFA Mung-25) produced a higher average yield of 1322 kg ha$^{-1}$ across Khyber Pakhtunkhwa compared with the average seed yield of 1,267 kg ha$^{-1}$ produced by the check variety AZRI Mung Jumbo (Table 10). Similarly, during evaluation in NUYT conducted in 2023, NIFA Mung-10 (NIFA Mung-25) produced an average higher seed yield of 1,207 kg ha$^{-1}$ compared with the check variety 'NIAB Mung-2021' (1,010 kg ha$^{-1}$) across KP (Table 11).

Development of new crop varieties having strong genetic potential for enhanced seed yield plays a key role in increasing per unit economic yield, coupled with an increase in overall productivity (Ahmad et al., 2007; Zulfiqar and Hussain, 2014; Joshi et al., 2017; Khattak et al., 2022, 2023). Additionally, genetic potential for high seed yield is of high preference for growers of specific crops (Hossain, 2012; Walker et al., 2015; Sedhom et al., 2024). Accordingly, the enhanced yield potential of NIFA Mung-25 across the Khyber Pakhtunkhwa province against the check varieties, i.e., AZRI Mung Jumbo and NIAB Mung-2021 in NUYTs (Tables 11 & 12), may play a positive role in increasing overall production of mungbean in the province. To be readily adopted by growers, a newly developed commercial variety of a crop must have a strong genetic potential for higher seed yield than other commercial varieties of the same crop under cultivation. NIFA Mung-25 produced an average of 8.8 and 15.1% more seed yield in NUYTs across the KP province compared with the National check varieties, AZRI Mung Jumbo and NIAB Mung-2021, respectively. Mungbean growers in the province will likely adopt NIFA Mung-25 to harvest substantial economic yield by exploiting its better genetic potential. In the contemporary age, growers are more inclined towards traits of economic value with high market acceptability and significant positive contribution to seed yield in a commercial crop variety (Carlson, 2007; Wale and Yalew, 2007; Poudel and Jhonsen, 2009; Asrat et al., 2010; Blazy et al., 2011; Smith and Fennessy, 2011; Ward et al., 2013; Kassie et al., 2017; Khattak et al., 2022, 2023). In Pakistan, bold seed size with shiny green color in mungbean is preferred by growers because of high market acceptability and economic returns. NIFA Mung-25 has a shiny green color with 4% average increase in seed size over the local check varieties. It is, therefore, expected that NIFA Mung-25 will positively contribute to enhancing mungbean productivity in the KP province in particular and the country in general.

Disease tolerance in new commercial crop varieties protects the genetic potential for high seed yield of the varieties. Chemical control is not economically viable on one hand, while on the other hand, it significantly contaminates the environment, thus posing potential threats to human and livestock health. The efficient way to avoid disease-induced damage to the yield of a potential crop variety is to incorporate genetic potential for disease resistance into the variety. Mungbean Yellow Mosaic Virus (MYMV) disease is highly detrimental to final economic yield, and resistance against MYMV is induced through aggregation of different beneficial genes having a modifying effect (Khattak et al., 2000). As inherent genetic potential for disease resistance plays a key role in the protection of yield potential (Oerke, 2006; Savary et al., 2012; Derbyshire et al., 2024), NIFA Mung-25 carries the genetic factors responsible for conferring resistance against the MYMV disease. This variety is therefore capable of performing better under MYMV disease prevalence.

**Table 2: Performance of NFM-103-30 (NIFA Mung-25) in preliminary yield trial at NIFA Peshawar in Kharif-2018**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-99-1 | NM98 × NFM-5-36-24 | 48 | 1690 |
| NFM-99-2 | -do- | 49 | 1732 |
| NFM-99-9 | -do- | 40 | 1273 |
| NFM-99-29 | -do- | 44 | 1786 |
| NFM-103-16 | V2802 × Ramzan | 49 | 1139 |
| NFM-103-30 | -do- | 51 | 1834 |
| NFM-103-57 | -do- | 47 | 1556 |
| Ramzan | Standard Check | 42 | 1444 |
| CV (%) | | 3.5 | 9.0 |
| LSD (*P* = 0.05) | | 2.6 | 69.4 |

TSW: Thousand-seed weight; SY: Seed yield

**Table 3: Performance of NFM-103-30 (NIFA Mung-25) in preliminary yield trial at NIFA Peshawar in Kharif-2020**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-99-1 | NM98 × NFM-5-36-24 | 44 | 2083 |
| NFM-99-2 | -do- | 48 | 1597 |
| NFM-99-9 | -do- | 43 | 1944 |
| NFM-99-38 | -do- | 48 | 1724 |
| NFM-103-16 | V2802 × Ramzan | 48 | 1493 |
| NFM-103-30 | -do- | 49 | 2269 |
| NFM-103-57 | -do- | 46 | 1828 |
| Ramzan | Standard Check | 48 | 2092 |
| CV (%) | | 2.82 | 9.14 |
| LSD (*P* = 0.05) | | 2.19 | 103.72 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 4: Performance of NFM-103-30 (NIFA Mung-25) in the advanced yield trial conducted at NIFA Peshawar in Kharif-2021**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-98-119 | NFM-5-36-24 × NFM-5-63-18 | 52 | 1646 |
| NFM-99-2 | NM98 × NFM-5-36-24 | 48 | 1694 |
| NFM-99-4 | -do- | 48 | 2188 |
| NFM-99-38 | -do- | 48 | 2312 |
| NFM-103-16 | V2802 × Ramzan | 50 | 1583 |
| NFM-103-30 | -do- | 50 | 2361 |
| NFM-103-57 | -do- | 41 | 1715 |
| NFM-103-90 | -do- | 52 | 2233 |
| NIFA Mung-19 | Standard Check | 50 | 1760 |
| CV (%) | | 1.46 | 6.60 |
| LSD (*P* = 0.05) | | 1.20 | 152.94 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 5: Performance of NFM-103-30 (NIFA Mung-25) in the adaptability yield trial conducted at ARS, Karak in Kharif-2021**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-98-85 | NFM-5-36-24 × NFM-5-63-18 | 51 | 1708 |
| NFM-98-119 | -do- | 52 | 1698 |
| NFM-99-2 | NM-98 × NFM-5-36-24 | 50 | 1613 |
| NFM-99-34 | -do- | 48 | 1498 |
| NFM-103-16 | V2802 × Ramzan | 50 | 1686 |
| NFM-103-30 | -do- | 50 | 1879 |
| NIFA Mung-19 | Standard Check | 49 | 1698 |
| AZRI Mung-18 | -do- | 48 | 1627 |
| CV (%) | | 1.36 | 5.42 |
| LSD (*P* = 0.05) | | 1.12 | 81.87 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 6: Performance of NFM-103-30 (NIFA Mung-25) in the adaptability yield trial conducted at AZRC, D.I. Khan in Kharif-2021**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-98-85 | NFM-5-36-24 × NFM-5-63-18 | 50 | 1565 |
| NFM-98-119 | -do- | 51 | 1745 |
| NFM-99-2 | NM-98 × NFM-5-36-24 | 50 | 1654 |
| NFM-99-34 | -do- | 49 | 1649 |
| NFM-103-16 | V2802 × Ramzan | 50 | 1765 |
| NFM-103-30 | -do- | 51 | 1845 |
| NIFA Mung-19 | Standard Check | 49 | 1623 |
| AZRI Mung-18 | -do- | 49 | 1602 |
| CV (%) | | 1.13 | 7.24 |
| LSD (*P* = 0.05) | | 1.16 | 109.63 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 7: Performance of NFM-103-30 (NIFA Mung-25) in the advanced yield trial conducted at NIFA Peshawar in Kharif-2022**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-99-2 | NM98 × NFM-5-36-24 | 42 | 1785 |
| NFM-99-4 | -do- | 48 | 1607 |
| NFM-99-38 | -do- | 47 | 1938 |
| NFM-103-16 | V2802 × Ramzan | 50 | 1715 |
| NFM-103-30 | -do- | 51 | 2189 |
| NFM-103-36 | -do- | 52 | 1950 |
| NFM-103-90 | -do- | 50 | 1815 |
| NIFA Mung-19 | Standard Check | 52 | 1742 |
| CV (%) | | 1.43 | 5.20 |
| LSD (*P* = 0.05) | | 1.14 | 97.58 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 8: Performance of NFM-103-30 (NIFA Mung-25) in the adaptability yield trial conducted at ARS, Karak in Kharif-2022**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-98-85 | NFM-5-36-24 × NFM-5-63-18 | 51 | 1597 |
| NFM-98-119 | -do- | 52 | 1424 |
| NFM-99-2 | NM-98 × NFM-5-36-24 | 50 | 1767 |
| NFM-99-34 | -do- | 48 | 1661 |
| NFM-103-16 | V2802 × Ramzan | 50 | 1795 |
| NFM-103-30 | -do- | 50 | 1879 |
| NFM-2019 | Standard Check | 49 | 1627 |
| AZRI Mung-18 | -do- | 48 | 1599 |
| CV (%) | | 1.13 | 7.69 |
| LSD (*P* = 0.05) | | 1.42 | 92.17 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 9: Performance of NFM-103-30 (NIFA Mung-25) in the adaptability yield trial planted at AZRC, D.I. Khan in Kharif-2022**

| Genotype | Parentage/Pedigree | TSW (g) | SY (kg ha$^{-1}$) |
|---|---|---|---|
| NFM-98-85 | NFM-5-36-24 × NFM-5-63-18 | 52 | 1647 |
| NFM-98-119 | -do- | 50 | 1523 |
| NFM-99-2 | NM-98 × NFM-5-36-24 | 51 | 1491 |
| NFM-99-34 | -do- | 49 | 1623 |
| NFM-103-16 | V2802 × Ramzan | 50 | 1787 |
| NFM-103-30 | -do- | 51 | 1947 |
| NIFA Mung-19 | Standard Check | 48 | 1771 |
| AZRI Mung-18 | -do- | 49 | 1758 |
| CV (%) | | 1.56 | 8.72 |
| LSD (*P* = 0.05) | | 1.92 | 101.40 |

TSW: Thousand-seed weight, SY: Seed yield

**Table 10: Mungbean National Uniform Yield Trial (seed yield, kg ha$^{-1}$) conducted by the Pulses Coordinator during Kharif 2022**

| Entry name | Institutes | Locations | | | | | | | | | | | Mean kg ha$^{-1}$ | Disease Reaction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |
| MH-14027 | NIAB, Faisalabad | 1283 | 1928 | 1646 | 813 | 1485 | 1042 | 961 | 1163 | 547 | 891 | 958 | 1156 | R |
| MH-13060 | NIAB, Faisalabad | 1176 | 1475 | 1528 | 684 | 1964 | 924 | 908 | 1265 | 433 | 1287 | 680 | 1120 | R |
| TM 1820 | AZRI, Bhakkar | 1331 | 1875 | 1320 | 937 | 1471 | 861 | 872 | 1068 | 476 | 1090 | 708 | 1092 | R |
| MMH-7142 | NIAB, Faisalabad | 1218 | 1744 | 1597 | 934 | 1569 | 910 | 610 | 1029 | 439 | 956 | 701 | 1064 | MR |
| MH-16006 | NIAB, Faisalabad | 1075 | 1656 | 1528 | 860 | 1388 | 917 | 872 | 1059 | 561 | 926 | 785 | 1057 | MR |
| PARB Mung 07 | AZRI, Bhakkar | 1139 | 1895 | 1444 | 823 | 1492 | 861 | 778 | 1044 | 513 | 669 | 611 | 1024 | R |
| MH-13089 | NIAB, Faisalabad | 1171 | 1813 | 903 | 985 | 1103 | 847 | 1074 | 1008 | 534 | 795 | 868 | 1009 | R |
| NIFA Mung-7 | NIFA, Peshawar | 1303 | 1824 | 1625 | 707 | 1180 | 924 | 877 | 994 | 288 | 698 | 611 | 1003 | R |
| PARB Mung 18 | AZRI, Bhakkar | 1323 | 1911 | 1458 | 720 | 1180 | 1028 | 771 | 993 | 310 | 757 | 562 | 1001 | MR |
| MM-17062 | NIAB, Faisalabad | 1137 | 1885 | 764 | 804 | 1438 | 889 | 922 | 1083 | 576 | 643 | 757 | 991 | R |
| PARB Mung 12 | AZRI, Bhakkar | 1225 | 1941 | 1181 | 842 | 1173 | 868 | 882 | 974 | 387 | 599 | 624 | 972 | R |
| TM-1821 | AZRI, Bhakkar | 1315 | 1315 | 1077 | 724 | 1520 | 993 | 883 | 1132 | 365 | 671 | 625 | 965 | R |
| NIFA Mung 10 | NIFA, Peshawar | 1392 | 1673 | 903 | 820 | 1180 | 840 | 714 | 911 | 460 | 915 | 653 | 951 | R |
| 18007 | PRI, Faisalabad | 1172 | 2174 | 868 | 636 | 1006 | 792 | 992 | 930 | 394 | 744 | 659 | 943 | R |
| MSPS 119 | PRP, NARC, Islamabad | 1101 | 1785 | 903 | 789 | 1117 | 972 | 763 | 951 | 420 | 862 | 611 | 934 | R |
| NIFA Mung-8 | NIFA, Peshawar | 1442 | 1664 | 937 | 770 | 1215 | 743 | 765 | 908 | 413 | 691 | 701 | 932 | R |
| AZRI Mung Jumbo (C) | AZRI, Bhakkar | 1127 | 1564 | 1111 | 767 | 1180 | 764 | 858 | 934 | 428 | 663 | 576 | 907 | R |
| NIFA Mung-9 | NIFA, Peshawar | 1286 | 1753 | 764 | 654 | 930 | 889 | 872 | 897 | 369 | 432 | 403 | 841 | R |
| 17002 | PRI, Faisalabad | 1216 | 1703 | 660 | 649 | 777 | 854 | 879 | 837 | 400 | 674 | 549 | 836 | R |
| Locations average | | 1233 | 1781 | 1159 | 785 | 1289 | 889 | 864 | 1014 | 440 | 790 | 665 | - | |

Locations: 1, ARI, Swat; 2, AZRC, D.I. Khan; 3, NIFA, Peshawar; 4, PRP, NARC; 5, NIAB Faisalabad; 6, BARI, Chakwal; 7, AZRI, Bhakkar; 8, AZRI, Umerkot; 9, PRI, Faisalabad; 10, GBRSS, Kallurkot; 11, BARI, Bahawalpur. R, Resistant; MR, Moderately resistant

**Table 11: Mungbean National Uniform Yield Trial (seed yield, kg ha$^{-1}$) conducted by the Pulses Coordinator during Kharif 2023**

| Code | Decode | Institutes | Locations | | | | | | | | | | | Mean kg ha$^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| MG23011 | MB-20009 | PRI, Faisalabad | 1140 | 1269 | 1479 | 811 | 599 | 660 | 2000 | 622 | 983 | 1018 | 1139 | 1065 |
| MG23012 | MH-13060 | NIAB, Faisalabad | 1024 | 1387 | 1667 | 547 | 796 | 646 | 1623 | 668 | 1087 | 1172 | 986 | 1055 |
| MG23013 | MHR-18032 | NIAB, Faisalabad | 983 | 1637 | 1778 | 523 | 652 | 611 | 1800 | 637 | 931 | 1049 | 986 | 1053 |
| MG23002 | PARB-Mung 12 | AZRI, Bhakkar | 940 | 1532 | 1681 | 700 | 671 | 479 | 1650 | 669 | 1076 | 1045 | 1049 | 1045 |
| MG23004 | MHR-18038 | NIAB, Faisalabad | 1089 | 1304 | 1688 | 819 | 559 | 549 | 1741 | 626 | 806 | 1160 | 1090 | 1039 |
| MG23007 | 18007 | PRI, Faisalabad | 892 | 1477 | 1639 | 507 | 862 | 493 | 2069 | 616 | 747 | 1042 | 1014 | 1033 |
| MG23015 | TM 1821 | AZRI, Bhakkar | 835 | 1505 | 1542 | 527 | 579 | 688 | 1481 | 750 | 1351 | 917 | 1153 | 1030 |
| MG23005 | NIFA-Mung-10 | NIFA, Peshawar | 610 | 1089 | 2153 | 858 | 593 | 438 | 1612 | 644 | 1201 | 845 | 1132 | 1016 |
| MG23018 | MB-20005 | PRI, Faisalabad | 1133 | 1338 | 1667 | 555 | 586 | 528 | 1711 | 605 | 896 | 1073 | 1042 | 1012 |
| MG23017 | E-8 | AZRC, D.I. Khan | 879 | 1172 | 1743 | 718 | 697 | 625 | 1616 | 631 | 698 | 1146 | 1035 | 996 |
| MG23016 | NIFA-Mung-7 | NIFA, Peshawar | 669 | 1609 | 1854 | 500 | 818 | 521 | 1372 | 599 | 993 | 1139 | 875 | 995 |
| MG23006 | NIAB Mung 2021 (C) | NIAB, Faisalabad | 1065 | 1304 | 1389 | 691 | 577 | 528 | 1807 | 727 | 858 | 997 | 917 | 987 |
| MG23021 | TM-1820 | AZRI, Bhakkar | 972 | 1484 | 1319 | 690 | 598 | 431 | 1469 | 640 | 1139 | 1087 | 993 | 984 |
| MG23009 | MH-16006 | NIAB, Faisalabad | 874 | 1054 | 1500 | 625 | 685 | 556 | 1829 | 687 | 781 | 1063 | 1070 | 975 |
| MG23020 | MM-17062 | NIAB, Faisalabad | 783 | 1255 | 1354 | 568 | 598 | 444 | 1729 | 725 | 840 | 1045 | 1250 | 963 |
| MG23001 | MB-20008 | PRI, Faisalabad | 1078 | 1137 | 1514 | 500 | 566 | 569 | 1866 | 623 | 813 | 931 | 986 | 962 |
| MG23003 | NIFA Mung-8 | NIFA, Peshawar | 706 | 853 | 2083 | 709 | 590 | 465 | 1333 | 695 | 1128 | 979 | 1007 | 959 |
| MG23019 | NIFA Mung-9 | NIFA, Peshawar | 639 | 1186 | 1750 | 583 | 696 | 597 | 1390 | 653 | 821 | 1083 | 882 | 935 |
| MG23010 | PARB Mung-7 | AZRI, Bhakkar | 619 | 1179 | 1646 | 526 | 564 | 569 | 1471 | 676 | 899 | 1067 | 972 | 926 |
| MG23014 | PARB Mung-18 | AZRI, Bhakkar | 532 | 832 | 1285 | 628 | 569 | 438 | 1946 | 778 | 924 | 1031 | 1028 | 908 |
| MG23008 | NCM-11-22 | PRP, NARC, Islamabad | 790 | 1130 | 1611 | 531 | 667 | 431 | 1237 | 684 | 924 | 912 | 882 | 891 |
| Locations average | | | 869 | 1273 | 1635 | 625 | 644 | 536 | 1655 | 665 | 947 | 1038 | 1023 | - |

**Table 12: Response of NFM-103-30 (NIFA Mung-25) to MYMV as compared to the parents and standards during Kharif 2018, 2020, and 2021**

| Entry | Mungbean Yellow Mosaic Virus (MYMV) disease rating | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | At NIFA, Peshawar-2018 | | | At NIFA, Peshawar-2020 | | | At NIFA, Peshawar-2021 | | |
| | % Infection | Score | Rating | % Infection | Score | Rating | % Infection | Score | Rating |
| NFM-99-1 | 7.5 | 2 | R | 7.2 | 2 | R | 7.3 | 2 | R |
| NFM-99-2 | 6.8 | 2 | R | 7.9 | 2 | R | 7.4 | 2 | R |
| NFM-103-16 | 7.4 | 2 | R | 7.4 | 2 | R | 7.7 | 2 | R |
| NFM-103-30 | 4.0 | 1 | HR | 4.3 | 1 | HR | 4.1 | 1 | HR |
| V2802 | 4.4 | 1 | HR | 4.1 | 1 | HR | 4.3 | 1 | HR |
| Ramzan | 4.5 | 1 | HR | 4.2 | 1 | HR | 3.9 | 1 | R |
| VC 1560D (Disease spreader) | 95.8 | 8 | HS | 96.4 | 8 | HS | 97.0 | 8 | HS |
| NIFA Mung-19 (Std. check) | 7.4 | 2 | R | 7.7 | 2 | R | 7.5 | 2 | HR |

| Plant parts infected/disease (%) | Score | Disease reaction |
|---|---|---|
| No infection | 0 | Immune (I) |
| 1-5 | 1 | Highly resistant (HR) |
| 6-10 | 2 | Resistant (R) |
| 11-20 | 3 | Moderately resistant (MR) |
| 21-30 | 4 | Tolerant (T) |
| 31-40 | 5 | Moderately tolerant (MT) |
| 41-50 | 6 | Moderately susceptible (MS) |
| 51-80 | 7 | Susceptible (S) |
| 81-100 | 8 | Highly susceptible (HS) |

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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).

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No supplementary material is included with this manuscript.

### Conflict of interest
The authors declare no conflict of interest.

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As per editorial policy, experimental materials, primary data, or software codes are not submitted to the publisher/Journal management. These are available with the corresponding author (s) and/or with other author(s) as declared by the corresponding author (s) of this manuscript.

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It is declared that the authors did not use any AI tools or AI-assisted services in the preparation, analysis, or creation of this manuscript submitted for publication in the International Journal of Applied and Experimental Biology (IJAaEB).

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