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GAMMA RAYS INDUCED HIGH YIELDING KABULI TYPE CHICKPEA MUTANT VARIETY "HASSAN-2K"

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Abstract

Pure seeds of a kabuli type chickpea exotic variety ILC-195 were irradiated at 0.45 kGy dose of gamma radiation in 1990 and the mutant line CMNK-287-3 was selected in M_3 generation on the basis of high yield, disease resistance and plant type. After confirmation of its resistance to blight and wilt in M_4 and M_5, the mutant line CMNK-287-3 alongwith other promising kabuli type chickpea mutants/varieties was evaluated in various yield trials and at different locations. The mutant line CMNK-287-3 was tested in advanced yield trial consecutively for two years, 1998-99 and 1999-2000 and yielded 2753 and 2554 kg/ha, respectively, as compared to the check varieties Noor-91(2200 kg/ha) and Pb-1(1022 kg/ha), respectively. The mutant line also proved superior in zonal yield trial, 1999-2000 by giving mean yield of 1496 kg/ha. The mutant line CMNK-287-3 has significantly higher protein content (23.89%) as compared to the parental variety ILC-195 (19.8%). The Provincial Seed Council approved the mutant line CMNK-287-3 by the name "Hassan-2K" for general cultivation in NWFP.

Introduction

Grain legumes occupy an important position in agriculture sector by virtue of their high protein content, low cost of production and ability of fixing atmospheric nitrogen. Among the grain legumes chickpea or gram (*Cicer arietinum* L) is one of the most important legume crop in Pakistan grown mostly on rainfed areas during rabi season. Being a major pulse crop it accounts for nearly 89% of the area and 90% of the production of rabi pulses, as such it constitutes around 71% of the total pulse production in the country. In NWFP where two third of the area is rainfed, 98% of the total chickpea area is grown in the southern zone where it is considered to be a cash crop. In Pakistan during 1998-99 it was cultivated on an area of 1.076 million hectares producing 0.698 million tons (Agriculture Statistics of Pakistan, 1998-99). The share of NWFP was 8.28 and 5.02% in area and production and thus the average yield during the last few years ranged from 540-650 kg/ha, which is very low as compared to the other chickpea growing countries of the world.

Moreover the chickpea grown in the country is of two main types, desi and kabuli. Desi is of brown seed coat colour with pink flower while kabuli type is with creamy seed testa, white flower and highly susceptible to diseases as compared to desi type. It has been reported by Malik (1990) that desi type contribute about 85% of annual world production and kabuli type accounts for the remaining 15%. In Pakistan 90% of the chickpea grown is desi while only 10% is kabuli, that is why the prices of kabuli type is much higher (Rs.45-55/kg) as compared to desi type (Rs.15-25/kg). So it is imperative to evolve varieties, which are not only high yielding but resistant to abiotic and biotic stresses. The paper describes the development of high yielding and disease resistant kabuli type chickpea variety "Hassan-2K" through induced mutations as a number of varieties of various crops have been released as reported by Maluszynski *et al*, (1991) by applying physical or chemical mutagens.

Material and method

The seed of an exotic kabuli type chickpea variety ILC-195 was irradiated with doses of 0.15 to 0.65-kGy gamma radiation in 1990 and M_1 generation was raised for creation of genetic variability for high yield, disease resistance and plant type. At maturity the seeds from single plants of different treatment were collected and planted in M_2 generation during 1990-91 as single plant progenies. At flowering the M_2 progenies were inoculated twice by spore suspension of *Ascochyta rabiei* (30,000 spores/ml) for creation epiphytic condition for blight. Humidity was maintained by spraying the water, which also helped to spread the disease. The disease reactions were recorded on a scale 1-9 (Singh *et al.*, 1981). A mutant line CMNK-287- was selected on the basis of disease resistance and yield in a dose of 0.45-kGy treatment. The seed of the mutant line CMNK-287 was planted as plant progeny rows 1991-92 in M_3 and after inoculation, the mutant line CMNK-287-3 was selected on the basis of high yield, blight resistance and plant type. The mutant line CMNK-287-3 was simultaneously tested in blight screening nurseries and different yield trials at the Institute and few other locations for confirmation of yield potential and adaptability. The observations on blight as well as other agronomic characteristics were recorded. The total protein estimation of the selected mutants was performed in triplicate by micro Kjaldahl method (% N x 6.25) in accordance with AOAC (1994). The results were statistically analysed by using analysis of variance (Steel and Torrie, 1980) with least significance difference to check the level of significance between the test entries.

Results and discussion

The yield and other agronomic performances of the kabuli type chickpea mutant CMNK-287-3 alongwith other promising mutants/varieties in advanced yield trial conducted at NIFA are given in Table-1. Significant differences were observed among the characters studied. In case of plant height mutant line CMNK-227-30 attained maximum plant height (93.3 cm) followed by CMNK-452-2 (86.7 cm) while the mutant lines CMNK-429-1 and 287-3 were the shortest having 80.0 & 84.8 cm plant height. As regard 100 seed weight all the mutants including CMNK-287-3 gave significantly greater 100 seed weight as compared to standard variety Pb-1 as well as parental variety ILC-195. The mutant line CMNK-220-4 gave significantly greatest 100 seed weight (28.8 g) followed by CMNK-227-30 (25.8 g) respectively. The mutant line CMNK-287-3 gave significantly higher harvest Index (39.9%) as compared to the check variety Pb-1 (30.9%) and parental variety ILC-195 (27.3%). Considering the yield performances, the mutant line CMNK-287-3 proved superior by producing 2554 kg/ha against the parental variety ILC-195 which yielded 1705 kg/ha. The mutant lines CMNK-281-7 & 239-17 produced significantly lower yields of 1747 & 1810 kg/ha, respectively. The mutant CMNK-287-3 was also evaluated in zonal yield trial with other eight promising mutants and two standard varieties Pb-1 and KC-98 during 1999-2000 over four locations to test their yielding ability and adaptability. The results in Table-2 revealed that considering the mean values, three mutant lines CMNK-429-1, 455-11 and 287-3 gave significantly higher yields, 1726, 1725 & 1648 kg/ha, respectively, as compared to the standard variety Pb-1 (1496 kg/ha).

The mutant line CMNK-287-3 alongwith other mutant lines and varieties was also screened for resistance against gram blight (*Ascochyta rabiei*) at NIFA and Nuclear Institute for Agriculture and Biology (NIAB) Faisalabad. The mutants CMNK-287-3, CMNK-247-30 and CMNK-316-54 showed medium resistant to tolerant type reaction while the parental variety ILC-195 proved to be highly susceptible (Table-3). Similarly the seed of twelve chickpea mutants including CMNK-287-3 and three varieties i-e Pb-1, Noor-91 and ILC-195 were analysed for their total protein content as it plays a vital role in human nutrition. The results in Table-4 showed that mutant line CMNK-287-3 gave significantly highest protein content (23.17%) among the mutant lines and the varieties tested for the purpose. The mutant CMNK-287-3 gave 16.6% more protein as compared to the parental variety ILC-195 (19.87%).

Induced mutation has played a significant role in development of many crop varieties (Micke, 1988) and is instrumental in enhancing genetic variability. Induced mutations in chickpea improvement at NIFA Peshawar have been successful in developing two chickpea mutant varieties (desi type) NIFA-88 (Hassan and Khan, 1991) and NIFA-95 (Hassan, *et al*, 1997), which are high yielding and disease resistant. Similarly recently a chickpea mutant variety CM-98 has been released by Haq *et al* (1999) on the basis of good plant type, high yield and resistance against *Ascochyta blight* and Fusarium wilt. A mungbean variety, NIAB Mung-98, has also been developed by Siddique Sadiq *et al* (1999), which has given 14 and 17% higher seed yield as compared to NM-51 and NM-20-21, respectively. The chickpea mutants having high harvest Index, yield and blight resistance have also been reported by Hassan and Khan (1991) as well as, Javed and Hassan (1995) as these are very important in predicting high yield especially in grain legumes. Nutritionally grain legumes are very important as a human diet. Therefore, the chickpea mutant having more total protein content as compared to the parental varieties have been reported by Shaikh *et al* (1982) and Hassan *et al* (1997). Therefore the chickpea mutant line CMNK-287-3 having high yield, moderately blight resistance and good quality was released under the name "Hassan-2K" by Provincial Seed Council in the meeting held on 30-9-2000 for general cultivation N.W.F.P.

Table 1. Performance of chickpea mutants (Kabuli) in Advanced yield trial at NIFA, 1999-2000.

Mutants	Plant height (cm)	100 seed wt. (g)	Harvest Index	Yield kg/ha
1. CMNK-220-4	86.5	28.8	36.2	2036
2. CMNK-227-30	93.3	25.8	31.2	1958
3. CMNK-239-17	85.3	22.6	28.3	1810
4. CMNK-281-7	86.6	24.0	28.6	1747
5. CMNK-287-3	84.8	23.9	39.9	2554
6. CMNK-429-1	80.0	22.2	36.5	2200
7. CMNK-440-9	85.2	21.8	34.1	2379
8. CMNK-452-2	86.7	22.7	32.2	2044
9. CMNK-455-11	85.3	24.3	34.6	2090
10. Pb-1	85.4	18.3	30.9	2309
11. ILC-195	83.3	17.9	27.3	1705
LSD (5%)	8.7	3.4	6.7	378.5

Table 2. Yield (Kg ha^{-1}) performance of chickpea mutants (Kabuli) in zonal trial 1999-2000.

Mutants	NIFA Peshawar	A.R.S. Karak	A.R.S. Nourang Bannu	AZRS D.I. Khan	Mean
1. CMNK-220-4	2036	575	1802	1373	1446
2. CMNK-227-30	1958	617	1690	1208	1368
3. CMNK-239-17	1810	492	1088	514	976
4. CMNK-281-7	1747	475	994	905	1030
5. CMNK-287-3	2554	922	1849	1266	1648
6. CMNK-429-1	2200	992	2130	1632	1726
7. CMNK-440-9	2379	848	1567	1471	1566
8. CMNK-452-2	2044	1224	1176	1470	1478
9. CMNK-455-11	2090	1388	1812	1611	1726
10. KC-98	-	1407	-	-	1407
11. Pb-1	2309	880	1531	1266	1496
LSD (%)	303.33	230.18	495.5	352.42	-

Table 3. Disease screening nurseries.

Entries No.	NIFA			NIAB
	1997-98	1998-99	1999-2000	1999-2000
1. CMNK-220-4	5	7	5	5
2. CMNK-227-30	5	3	5	3
3. CMNK-229-15	3	5	5	3
4. CMNK-233-37	7	5	7	5
5. CMNK-239-17	5	7	5	5
6. CMNK-247-30	3	3	5	3
7. CMNK-250-3	7	7	9	7
8. CMNK-250-22	7	5	7	5
9. CMNK-262-5	7	5	7	5
10. CMNK-262-26	5	7	7	7
11. CMNK-263-3	7	7	7	7
12. CMNK-270-40	7	9	7	7
13. CMNK-281-7	7	7	9	7
14. CMNK-287-3	3	3	5	5
15. CMNK-300-95	5	5	7	5
16. CMNK-316-54	5	3	5	3
17. CMNK-402-5	7	7	7	7
18. CMNK-406-4	9	9	7	7
19. CMNK-408-4	5	5	7	5
20. CMNK-410-6	5	7	7	5
21. CMNK-411-7	7	5	7	5
22. CMNK-412-9	7	9	9	7
23. CMNK-417-6	7	5	7	5
24. CMNK-425-10	7	7	5	5
25. CMNK-427-8	7	9	9	7
26. CMNK-429-1	7	5	5	5
27. CMNK-431-6	9	7	7	7
28. CMNK-440-9	7	9	9	7
29. CMNK-452-2	7	5	5	5
30. CMNK-455-11	7	5	7	5
31. Pb-1	7	7	7	7
32. Noor-91	7	7	7	5
33. ILC-195	7	9	9	-

Disease was scored on 1-9 scale where 1= Highly resistant 3- moderately resistant 5= Average reaction 7-moderately susceptible 9= Highly susceptible.

Table 4. Protein Percentage of chickpea varieties.

7	1998-99	1999-2000	Mean
1. CMNK-220-4	20.03	19.82	19.82
2. CMNK-227-30	19.51	19.54	19.52
3. CMNK-239-17	21.18	20.57	20.88
4. CMNK-250-3	22.06	21.80	21.93
5. CMNK-262-26	20.30	19.50	19.90
6. CMNK-281-7	20.82	19.53	20.17
7. CMNK-287-3	23.84	22.56	23.17
8. CMNK-425-10	21.18	21.50	21.34
9. CMNK-427-8	20.73	20.55	20.64
10. CMNK-429-1	21.70	20.64	21.17
11. CMNK-440-9	21.08	21.00	21.04
12. CMNK-452-2	20.65	19.80	20.22
13. Pb-1	19.51	20.70	20.10
14. Noor-91	20.03	19.53	19.78
15. ILC-95	19.50	20.25	19.87
LSD (%)	1.26	2.46	-

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