Journal of Spices and Aromatic Crops Vol. 21 (1): 68–70 (2012)

www.indianspicesociety.in/josac/index.php/josac



## Identification of fertility restorer and sterility maintainer lines in chilli (Capsicum annuum L.)<sup>1</sup>

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Received 21 October 2011; Revised 26 December 2011; Accepted 29 December 2011

## **Abstract**

Three cytoplasmic geneic male sterile lines of chilli (*Capsicum annuum* L.) namely, JNKVVA1, ACBGA1 and ACBGA2 showed 100% male sterility when tested with 1% acetocarmine solution. Among the 50 chilli lines crossed with the three male sterile lines, 36 lines were stable for fertility restoration (Rf) while, two lines namely, AVNPC131 and X235 were identified as sterility maintainers (rf).

Keywords: chilli hybridization, inbred segregation, stable restorers, sterility maintainers

The process of emasculation and pollination in chilli (*Capsicum annuum* L.) for hybrid seed production is a cumbersome practice. Utilization of a stable commercial viable male sterility source in chilli would help in making the hybridization process easy and economically viable. In the present study, three cytoplasmic male sterile lines were evaluated to identify stable male sterile lines.

Three cytoplasmic genetic male sterile lines namely, JNKVVA1, ACBGA1 and ACBGA2 were grown in a shade house from 15<sup>th</sup> August 2008 to 30<sup>th</sup> June 2009 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (Madhya

Pradesh). ACBGA1 and ACBGA2 were obtained from University of Agricultural Sciences, Dharwad and JNKVVA1 from Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur. On the basis of pollen dehiscence the plants were classified as male fertile or male sterile. The number of stained pollen grains was evaluated by microscopic examination (Gulyas *et al.* 2006). Cytoplasmic male sterility is important in many crops for F<sub>1</sub> hybrid seed production as well as for research on nuclear mitochondrial interaction (Chase 2007). Fifty chilli lines were crossed with each of the three male sterile lines to produce 150 F<sub>1</sub> hybrids

<sup>&</sup>lt;sup>1</sup>Based on a part of PhD thesis of the first author submitted to Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur.

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during kharif 2008 and sown in shade house as well as in the field. Based on their fertility restoration, inbred plants were classified into three categories: (i) stable for fertility restoration (Rf) (ii) stable for sterility maintainer (rf) and (iii) inbred plants still segregating (Rf/rf) (Kumar *et al.* 2007).

Out of the 150 F<sub>1</sub> fertility was restored in 117, partially restored in 21 and sterility was maintained in 12 when tested during summer 2009 in shade house conditions in pots (Table 1). Under shade house during kharif 2009, fertility was restored in 109, partially restored in 30 and sterility maintained in 11 (Table 1). However, under field conditions, fertility was restored in 116, partially restored in 24 and sterility maintained in 10 hybrids (Table 1). Variations were observed for the presence of fertility restorer gene Rf in the genotypes used as male on CMS lines.

**Table 1.** Fertility restorer, sterility maintainer and segregating lines under shade house and field condition in chilli

Total hybrids	Fertility restorer	Partial restorer	Sterility maintainer							
Net house										
150	117	21	12							
Shade house										
150	109	30	11							
Field										
150	116	24	10							

The stable restorers (lines which restore fertility after crossing with all three sterile lines) as well as sterility maintainer lines (lines which restore sterility after crossing with all three sterile lines) are presented in Table 2. Among the 50 lines, 36 lines, namely, Shankeswar, JM-218, Pant C-1, G-4, K1-4, 9608U, BVC-1, GUK-1, GUK-2, GUK-2-1, GUK-2-1-1, IC119578, IC119561, LCA-235, LCA-304, LCA-310, LCA-310A, LCA-334, LCA-960, KDC-1, GPC-82, D. DABBI, KDSC210-10-3, KDSC210-10-4, KDSC210-10, SUM05-2R, P. JWALA, KA-2, K1-4 D, HMT-1,

B. Kaddi, Jayanti, GCV111, GCV131, P. Sadabahar and BVC-37, were stable for fertility restoration (Rf) while, two lines namely, AVNPC131 and X235 were identified as sterility maintainers (rf) whereas, remaining 12 lines namely, Phule Jyoti, Hisar Vijay, H0413, IC119243, IC112109, KDSC210-10-1. KDSC210-10-2, KDSC510-10-1, KDSC510-10-2, KDSC510-10, HCS-3 and JM-283 were found segregating (Rf/rf). Fertility restoration analysis revealed presence of fertility restoration gene Rf in majority of the lines. Similar findings have also been reported earlier in chilli by testing different lines (Kumar *et al.* 2004; Singh *et al.* 2006).

It could be concluded from the study that all the three male sterile lines were stable for cytoplasmic male sterility over different seasons at Jabalpur. Fertility restoration analysis revealed the presence of fertility restoration and sterility maintainer gene in thirty six and two lines respectively. Majority of the lines exhibited fertility restoration gene (Rf) whereas, only two lines namely, AVNPC131 and X235 exhibited sterility maintainer gene (rf). Hence, these two lines may be used for conversion into male sterility through back crossing to create genetic variability for male sterility in chilli.

## References

- Chase C D 2007 Cytoplasmic male sterility: a window to the world of plant mitochondrial-nuclear interactions. Trends Gen. 23: 81–90.
- Gulyas G, Pakozdi K, Lee J S & Hirata Y 2006 Analysis of fertility restoration by using cytoplasmic male sterile red pepper (*Capsicum annuum* L.) lines. Breeding Sci. 56: 331–334.
- Kumar S, Rai S K, Singh M & Rai M 2004 Fertility restoration in pepper (*Capsicum annuum* L.) inheritance and screening of inbred lines. Veg. Sci. 31: 101–106.
- Kumar S, Singh V, Singh M, Rai S K, Kumar S & Rai M 2007 Genetics and distribution of fertility restoration associated RAPD markers in inbreds of pepper (*Capsicum annuum* L.). Sci. Hort. 111: 197–202.
- Singh T K, Kumar S, Singh M, Kumar S, Singh G & Rai M 2006 Characterization of recombinant inbred lines (RILs) of *Capsicum annuum* L. Veg. Sci. 33: 201–202.

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Table 2. Stable fertility restorer and sterility maintainer lines in chilli

No.   Insert   Free   Population   Section   Free   Population	Table 2. Stable fertility restorer and sterility maintainer lines in chilli										
No. Lines used population as male   Fertile   (%) fertile   Fertile   (%) fertile   Remark   plants in F <sub>1</sub>     Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F				Tester used as female (CGMS)							
No. Lines used population as male   Fertile   (%) fertile   Fertile   (%) fertile   Remark   plants in F <sub>1</sub>     Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F <sub>1</sub>   Plants in F	S1	Cl E plant					TBGA1	,			
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Sankeshwar		as male		rertile						Kemark	
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3	1	Sankeshwar	40	40	100	40	100	40	100	Rf	
4 G-4	2	JM-218	40	40	100	40	100	40	100	Rf	
4 G-4	3	Pant C-1	40	40	100	40	100	40	100	Rf	
5         K1-4C         40         40         100         40         100         40         100         Rf           6         9608U         40         40         100         40         100         40         100         Rf           7         BVC-1         40         40         100         40         100         40         100         Rf           9         GUK-2         40         40         100         40         100         40         100         Rf           10         GUK-2-1         40         40         100         40         100         40         100         Rf           11         GUK-2-1         40         40         100         40         100         40         100         Rf           12         ICT19578         40         40         100         40         100         40         100         Rf           12         ICT19578         40         40         100         40         100         40         100         Rf           12         ICA-310A         40         40         100         40         100         40         100         Rf											
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13         IC119561         40         40         100         40         100         40         100         Rf           14         LCA-235         40         40         100         40         100         40         100         Rf           15         LCA-3104         40         40         100         40         100         40         100         Rf           16         LCA-310A         40         40         100         40         100         40         100         Rf           17         LCA-310A         40         40         100         40         100         40         100         Rf           18         LCA-960         40         40         100         40         100         40         100         Rf           20         KDC-1         40         40         100         40         100         40         100         Rf           21         GPC-82         40         40         100         40         100         40         100         Rf           22         D.DABBI         40         40         100         40         100         Rf         40         100 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>											
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15         LCA-304         40         40         100         40         100         40         100         Rf           16         LCA-310A         40         40         100         40         100         40         100         Rf           17         LCA-310A         40         40         100         40         100         40         100         Rf           18         LCA-360         40         40         100         40         100         40         100         Rf           19         LCA-960         40         40         100         40         100         40         100         Rf           20         KDSC-1         40         40         100         40         100         Rf											
16         LCA-310         40         40         100         40         100         40         100         Rf           17         LCA-310A         40         40         100         40         100         40         100         Rf           18         LCA-360         40         40         100         40         100         40         100         Rf           19         LCA-960         40         40         100         40         100         40         100         Rf           20         KDC-1         40         40         100         40         100         40         100         Rf           21         GPC-82         40         40         100         40         100         Rf         100         Rf         22         D.DABBI         40         40         100         40         100         Rf         23         KDSC210-10-3         40         40         100         40         100         40         100         Rf         23         KDSC210-10-3         40         40         100         40         100         40         100         Rf         25         KDSC210-10-3         40         40 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>											
17 LCA-310A 40 40 100 40 100 40 100 Rf 18 LCA-334 40 40 40 100 40 100 40 100 Rf 19 LCA-960 40 40 100 40 100 40 100 Rf 20 KDC-1 40 40 100 40 100 40 100 Rf 21 GPC-82 40 40 100 40 100 40 100 Rf 22 D.DABBI 40 40 100 40 100 40 100 Rf 23 KDSC210-10-3 40 40 100 40 100 40 100 Rf 24 KDSC210-10-4 40 40 100 40 100 40 100 Rf 25 KDSC210-10 40 40 100 40 100 40 100 Rf 26 SUM05-2R 40 40 100 40 100 40 100 Rf 27 P. jwala 40 40 100 40 100 40 100 Rf 28 KA-2 40 40 100 40 100 40 100 Rf 30 HMT-1 40 40 100 40 100 40 100 Rf 31 B. Kaddi 40 40 100 40 100 40 100 Rf 31 B. Kaddi 40 40 100 40 100 40 100 Rf 32 JAYANTI 40 40 100 40 100 40 100 Rf 33 GCV111 40 40 40 100 40 100 40 100 Rf 34 GCV131 40 40 100 40 100 40 100 Rf 35 P. Sadabahar 40 40 100 40 100 40 100 Rf 36 BVC-37 40 40 100 40 100 40 100 Rf 37 AVNPC131 40 00 00 00 00 00 00 00 Rf 38 X235 40 00 00 00 00 00 00 Rf/rf 40 Hisar Vijay 40 35 87.5 38 95 25 66.5 Rf/rf 41 H0413 40 35 87.5 38 95.5 13 32.5 Rf/rf 44 KDSC210-10-1 40 34 85 00 00 00 Rf/rf 45 KDSC210-10-1 40 34 85 00 00 00 Rf/rf 47 KDSC510-10-1 40 34 85 00 00 00 Rf/rf 48 KDSC510-10-1 40 34 85 00 00 00 Rf/rf 48 KDSC510-10-2 40 34 85 00 00 00 00 Rf/rf 48 KDSC510-10-1 40 34 85 00 00 00 00 Rf/rf 49 HCS-3 40 40 100 00 00 00 00 00 Rf/rf 49 KDS-3 40 00 00 00 00 00 00 00 Rf/rf 49 KDS-3 40 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 00 Rf/rf 49 HCS-3 40 00 00 00 00 00 00 00 00 00 Rf/rf											
18         LCA-334         40         40         100         40         100         40         100         Rf           19         LCA-960         40         40         100         40         100         40         100         Rf           20         KDC-1         40         40         100         40         100         40         100         Rf           21         GPC-82         40         40         100         40         100         40         100         Rf           22         D.DABBI         40         40         100         40         100         40         100         Rf           24         KDSC210-10-3         40         40         100         40         100         40         100         Rf           24         KDSC210-10         40         40         100         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf											
19 LCA-960											
20         KDC-1         40         40         100         40         100         40         100         Rf           21         GPC-82         40         40         100         40         100         40         100         Rf           22         D.DABBI         40         40         100         40         100         Mo         100         Rf           23         KDSC210-10-3         40         40         100         40         100         40         100         Rf           24         KDSC210-10-4         40         40         100         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf           26         SUM05-2R         40         40         100         40         100         40         100         Rf           27         P. jwala         40         40         100         40         100         Rf         100         Rf           28         K.4-2         40         40         100         40         100         Rf         100         Rf											
21         GPC-82         40         40         100         40         100         40         100         Rf           22         D.DABBI         40         40         100         40         100         40         100         Rf           23         KDSC210-10-3         40         40         100         40         100         Mo         100         Rf           24         KDSC210-10-4         40         40         100         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf           26         SUM05-2R         40         40         100         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           29         K1-4         D         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         Rf           31         <											
22         D. DABBI         40         40         100         40         100         40         100         Rf           23         KDSC210-10-3         40         40         100         40         100         40         100         Rf           24         KDSC210-10         40         40         100         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf           26         SUM05-2R         40         40         100         40         100         40         100         Rf           27         P. jwala         40         40         100         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           29         K1-4         D         40         100         40         100         Rf         30         HMT-1         40         40         100         40         100         Rf         31         B. Kaddi         40         40         100											
23         KDSC210-10-3         40         40         100         40         100         40         100         Rf           24         KDSC210-10-4         40         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf           26         SUM05-2R         40         40         100         40         100         40         100         Rf           27         P. jwala         40         40         100         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           28         KI-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         Rf         31         B. Kaddi         40         40         100         40         100         Rf         32         JAYANTI         40         40         100         40         100 </td <td></td>											
24         KDSC210-10-4         40         40         100         40         100         40         100         Rf           25         KDSC210-10         40         40         100         40         100         40         100         Rf           26         SUM05-2R         40         40         100         40         100         40         100         Rf           27         P. jwala         40         40         100         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           29         KI-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         Rf         34         GCV131											
25         KDSC210-10         40         40         100         40         100         40         100         Rf           26         SUM05-2R         40         40         100         40         100         Rf           27         P. jwala         40         40         100         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           29         K1-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         A0         100         Rf           32         JAYANTI         40         40         100         40         100         A0         100         Rf           34         GCV131         40         40         100         40         100         Rf           35         P. Sadabahar         40											
26         SUM05-2R         40         40         100         40         100         40         100         Rf           27         P. jwala         40         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           29         KI-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         40         100         Rf           33         GCV131         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         Rf         M         100         Rf         M         100 <td></td>											
27         P. jwala         40         40         100         40         100         Rf           28         KA-2         40         40         100         40         100         40         100         Rf           29         KI-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         40         100         Rf           33         GCV111         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         Rf           36         BVC-37         40         40         100 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>											
28         KÁ-2         40         40         100         40         100         40         100         Rf           29         K1-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         Rf         100         Rf											
29         K1-4 D         40         40         100         40         100         40         100         Rf           30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         40         100         Rf           33         GCV111         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         rf           38         X23											
30         HMT-1         40         40         100         40         100         40         100         Rf           31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         40         100         Rf           33         GCV111         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         A0         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         rf           38         X235         40         00         00         00         00         00         Rf/rf           40 </td <td></td>											
31         B. Kaddi         40         40         100         40         100         40         100         Rf           32         JAYANTI         40         40         100         40         100         40         100         Rf           33         GCV111         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         A0         100         Rf           36         BVC-37         40         40         100         40         100         Mo         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         00         00         rf           38         X235         40         00         00         00         00         00         Rf/rf											
32       JAYANTI       40       40       100       40       100       40       100       Rf         33       GCV111       40       40       100       40       100       40       100       Rf         34       GCV131       40       40       100       40       100       40       100       Rf         35       P. Sadabahar       40       40       100       40       100       40       100       Rf         36       BVC-37       40       40       100       40       100       40       100       Rf         37       AVNPC131       40       00       Rf/rf       40       100       Rf/rf       41       HO413 <td></td>											
33         GCV111         40         40         100         40         100         40         100         Rf           34         GCV131         40         40         100         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         40         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         00         00         00         00         00         00         00         00         00         rf         38         X235         40         00         00         00         00         00         00         00         rf         39         Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf         40         Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf         41         HO413         40         100											
34         GCV131         40         40         100         40         100         40         100         Rf           35         P. Sadabahar         40         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         40         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         00         00         rf           38         X235         40         00         00         00         00         00         00         00         rf           39         Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf           40         Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf           41         H0413         40         35         87.5         38         95         25         62.5         Rf/rf           42         IC119243         40         40         100         26         65         40         100											
35         P. Sadabahar         40         40         100         40         100         40         100         Rf           36         BVC-37         40         40         100         40         100         40         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         00         00         rf           38         X235         40         00         00         00         00         00         00         00         00         rf           39         Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf           40         Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf           41         H0413         40         35         87.5         38         95         25         62.5         Rf/rf           42         IC119243         40         40         100         26         65         40         100         Rf/rf           43         IC112109         40         34         85         40 <td></td>											
36         BVC-37         40         40         100         40         100         40         100         Rf           37         AVNPC131         40         00         00         00         00         00         00         00         rf           38         X235         40         00         00         00         00         00         00         00         rf           39         Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf           40         Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf           41         H0413         40         35         87.5         38         95         25         62.5         Rf/rf           42         IC119243         40         40         100         26         65         40         100         Rf/rf           43         IC112109         40         34         85         40         100         00         00         Rf/rf           45         KDSC210-10-1         40         34         85         27         67.5         25<											
37         AVNPC131         40         00         00         00         00         00         00         00         rf           38         X235         40         00         00         00         00         00         00         rf           39         Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf           40         Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf           41         H0413         40         35         87.5         38         95         25         62.5         Rf/rf           42         IC119243         40         40         100         26         65         40         100         Rf/rf           43         IC112109         40         34         85         40         100         00         00         Rf/rf           44         KDSC210-10-1         40         32         80         35         87.5         13         32.5         Rf/rf           45         KDSC210-10-2         40         34         85         27         67.5         25											
38         X235         40         00         00         00         00         00         00         rf           39         Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf           40         Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf           41         H0413         40         35         87.5         38         95         25         62.5         Rf/rf           42         IC119243         40         40         100         26         65         40         100         Rf/rf           43         IC112109         40         34         85         40         100         00         00         Rf/rf           44         KDSC210-10-1         40         32         80         35         87.5         13         32.5         Rf/rf           45         KDSC210-10-2         40         34         85         27         67.5         25         62.5         Rf/rf           46         KDSC510-10-1         40         34         85         00         00         35         87.5											
39 Phule Jyoti         40         36         90         35         87.5         40         100         Rf/rf           40 Hisar Vijay         40         35         87.5         36         90         40         100         Rf/rf           41 H0413         40         35         87.5         38         95         25         62.5         Rf/rf           42 IC119243         40         40         100         26         65         40         100         Rf/rf           43 IC112109         40         34         85         40         100         00         00         Rf/rf           44 KDSC210-10-1         40         32         80         35         87.5         13         32.5         Rf/rf           45 KDSC210-10-2         40         34         85         27         67.5         25         62.5         Rf/rf           46 KDSC510-10-1         40         40         100         35         87.5         40         100         Rf/rf           47 KDSC510-10-2         40         34         85         00         00         35         87.5         Rf/rf           48 KDSC510-10         40         34         85											
40       Hisar Vijay       40       35       87.5       36       90       40       100       Rf/rf         41       H0413       40       35       87.5       38       95       25       62.5       Rf/rf         42       IC119243       40       40       100       26       65       40       100       Rf/rf         43       IC112109       40       34       85       40       100       00       00       Rf/rf         44       KDSC210-10-1       40       32       80       35       87.5       13       32.5       Rf/rf         45       KDSC210-10-2       40       34       85       27       67.5       25       62.5       Rf/rf         46       KDSC510-10-1       40       40       100       35       87.5       40       100       Rf/rf         47       KDSC510-10-2       40       34       85       00       00       35       87.5       Rf/rf         48       KDSC510-10       40       34       85       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00											
41       H0413       40       35       87.5       38       95       25       62.5       Rf/rf         42       IC119243       40       40       100       26       65       40       100       Rf/rf         43       IC112109       40       34       85       40       100       00       00       Rf/rf         44       KDSC210-10-1       40       32       80       35       87.5       13       32.5       Rf/rf         45       KDSC210-10-2       40       34       85       27       67.5       25       62.5       Rf/rf         46       KDSC510-10-1       40       40       100       35       87.5       40       100       Rf/rf         47       KDSC510-10-2       40       34       85       00       00       35       87.5       Rf/rf         48       KDSC510-10-2       40       34       85       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00       00       00       00       Rf/rf         50       JM-283       40       27       67.5       26											
42       IC119243       40       40       100       26       65       40       100       Rf/rf         43       IC112109       40       34       85       40       100       00       00       Rf/rf         44       KDSC210-10-1       40       32       80       35       87.5       13       32.5       Rf/rf         45       KDSC210-10-2       40       34       85       27       67.5       25       62.5       Rf/rf         46       KDSC510-10-1       40       40       100       35       87.5       40       100       Rf/rf         47       KDSC510-10-2       40       34       85       00       00       35       87.5       Rf/rf         48       KDSC510-10-2       40       34       85       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00       00       00       00       Rf/rf         50       JM-283       40       27       67.5       26       65       28       70       Rf/rf		, ,									
43       IC112109       40       34       85       40       100       00       00       Rf/rf         44       KDSC210-10-1       40       32       80       35       87.5       13       32.5       Rf/rf         45       KDSC210-10-2       40       34       85       27       67.5       25       62.5       Rf/rf         46       KDSC510-10-1       40       40       100       35       87.5       40       100       Rf/rf         47       KDSC510-10-2       40       34       85       00       00       35       87.5       Rf/rf         48       KDSC510-10       40       34       85       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00       00       00       00       Rf/rf         50       JM-283       40       27       67.5       26       65       28       70       Rf/rf											
44       KDSC210-10-1       40       32       80       35       87.5       13       32.5       Rf/rf         45       KDSC210-10-2       40       34       85       27       67.5       25       62.5       Rf/rf         46       KDSC510-10-1       40       40       100       35       87.5       40       100       Rf/rf         47       KDSC510-10-2       40       34       85       00       00       35       87.5       Rf/rf         48       KDSC510-10       40       34       85       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00       00       00       00       Rf/rf         50       JM-283       40       27       67.5       26       65       28       70       Rf/rf											
45         KDSC210-10-2         40         34         85         27         67.5         25         62.5         Rf/rf           46         KDSC510-10-1         40         40         100         35         87.5         40         100         Rf/rf           47         KDSC510-10-2         40         34         85         00         00         35         87.5         Rf/rf           48         KDSC510-10         40         34         85         00         00         00         00         Rf/rf           49         HCS-3         40         40         100         00         00         00         00         Rf/rf           50         JM-283         40         27         67.5         26         65         28         70         Rf/rf											
46       KDSC510-10-1       40       40       100       35       87.5       40       100       Rf/rf         47       KDSC510-10-2       40       34       85       00       00       35       87.5       Rf/rf         48       KDSC510-10       40       34       85       00       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00       00       00       00       Rf/rf         50       JM-283       40       27       67.5       26       65       28       70       Rf/rf											
47     KDSC510-10-2     40     34     85     00     00     35     87.5     Rf/rf       48     KDSC510-10     40     34     85     00     00     00     00     00     Rf/rf       49     HCS-3     40     40     100     00     00     00     00     Rf/rf       50     JM-283     40     27     67.5     26     65     28     70     Rf/rf											
48       KDSC510-10       40       34       85       00       00       00       00       Rf/rf         49       HCS-3       40       40       100       00       00       00       00       Rf/rf         50       JM-283       40       27       67.5       26       65       28       70       Rf/rf											
49 HCS-3       40       40       100       00       00       00       00       Rf/rf         50 JM-283       40       27       67.5       26       65       28       70       Rf/rf											
50 JM-283 40 27 67.5 26 65 28 70 Rf/rf											
<u> </u>											
						26	65	28	70	Kt/rt	

Rf=Fertility restoration; rf=sterility maintainer