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Research Paper

INHERITANCE OF RESTORER GENE IN CHILLI (*Capsicum annuum* L.)

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Abstract

An investigation was carried out to study the inheritance of restorer gene in the 33 CMS based F1 crosses. All these plants were uniform in terms of plant height and fruit parameters and were all fertile pollen, there by indicating dominant nature of restoration. The segregated population were maintained by subsequent self pollination. Since the restorer gene occur in the nucleus, segregation of pollen production in the F2 generation was observed. This segregating pattern (3:1) indicted a mono-functional inheritance associated with the restorer genes. Among 33 hybrids 24 hybrids clearly segregated in 3:1 ratio, whereas in 9 hybrids there was deviation from expected mendelian ratio, this could be because the presence of modifier gene.

Key words: *CGMS, restorers, inheritance, populations.*

INTRODUCTION

Chilli (Capsicum annuum L.) is an important vegetable cum spice crop grown in almost all parts of tropical and subtropical regions of the world. It has several uses, where highly pungent types with thin and comparatively smooth pericarp are used in hot sauces, in dry powder and in pharmaceutical industry as per Singh (6). Although majority of Indian farmers cultivate locally adopted varieties, hybrid cultivar have recently became popular. The process of' emasculation and pollination in chilli (Capsicum annum L.) for hybrid seed production is a cumbersome and costly practice. Thereby, scientists inspired to search for commercially viable male sterility source in chilli, for making hybridization process easy and economically viable by Chase (1). This paved the way for intensification of research in utilization of male sterility systems in hot pepper. Now, different male sterility systems are available in hot pepper. Among these, cytoplasmic genetic male sterility (CGMS) system appears to be a good substitute for hand emasculation to curtail the cost of hybrid seed to a great extent. In addition the *CMS/Rf* system provides an excellent model for the study of nuclear mitochondrial interaction in multicellular organism. The identification of fertility restorer and sterility maintainer from available germplasm for CMS line is important to broaden the genetic base in heterosis breeding program. Though attempts have been made over decades it has not been possible to develop and commercialize CGMS based hybrids. Reasons are attributed mainly to incompatibility between the sterile cytoplasm and the nucleus endowed with restorer gene complex and non-availability of effective restorers to overcome the strong negative effects of sterile cytoplasm as per Huang W (4).

A good restorer line must have efficient and stable fertility restoration ability combined with desirable agronomic characters. Therefore, breeding of efficient and stable fertility restorer lines (R-line) is the need of hour. An attempt was made at Botany department, Yeshwantrao Chavan College Tulajapur to study genetics of restorer's gene for development of CGMS hybrid.

MATERIAL AND METHODS

In the present study a CMS lines namely CCA-4261 was acquired from AVRDC Taiwan and 33 pure lines were requested and received from department of botany college of Yeshwantrao Chavan Tulajapur. All the material were planted in the experimental field in the kharif season of 2014. The crop was planted at 60 X 45 cm spacing. The CMS line CCA-4261 was used as female and 33 pure lines were used as male to develop 33 hybrids. In 2015 33 hybrids were transplanted in the field with same spacing as above. On the basis of pollen dehiscence the plants were classified as male fertile and male sterile, as per Tembhurne (7). The hybrids were visually observed at flowering stage for the presence or absence of anthers and checked for the pollen production. All hybrids were having good quantity of pollen grain. The F2 generation seed were obtained by selfing of F1 plants. Cytoplasmic male sterility is important in many crops for hybrid seed production as well as for research on nuclear and mitochondrial interaction. As per Kumar et al.(5) Based on their fertility restoration, inbred plants were classified into three categories (i) Stable for fertility restoration (ii) stable for sterility maintainer (iii) inbred plants still segregating

RESULTS AND DISCUSSION

The cross between cytoplasmic male sterile line CCA-4261 and 33 pure lines resulting in 33 survival F1 hybrids. All these plants were uniform in terms of plant height and fruit parameters and were all fertile pollen, there by indicating dominant nature of restoration. The chi-square analyses for the observed and expected number of male sterile and male fertile plants showed good fit between the observed and expected ratio. Coincidentally, there was near complete agreement between the observed and expected number of male sterile and male fertile plants, when data of all the crosses were pooled. The segregated population were maintained by subsequent self pollination. Since the restorer gene occur in the nucleus, segregation of pollen production in the F2 generation was observed. Analysis of the pollen content and the amount of viable pollen grains in the individual of the F2 generation revealed that 75 plants were male fertile and 25 were male sterile. This segregating pattern (3:1) indicted a mono-functional inheritance associated with the restorer genes. Among 33 hybrids 24 hybrids clearly segregated in 3:1 ratio, whereas in 9 hybrids there was deviation from expected mendelian ratio, given in Table 1. Same have been reported in previous studies by Gulyas et al (3),Kumar et al (5) and Singh et al (6).

Table 1 : Segregation of the F2 generation for the fertile and sterile plants

Crosses	Total number of plants	Number of fertile plants	No. of sterile plants	Ratio (F:S)	χ2	P value
HPH-1	100	31	69	3 : 1	0.21	0.64
HPH-2	100	28	72	3 : 1	0.48	0.49
HPH-3	100	23	77	3 : 1	0.21	0.64
HPH-4	100	36	64	Deviating from 3 : 1	6.45	0.01
HPH-5	100	30	70	3 : 1	1.33	0.25
HPH-6	100	37	63	Deviating from 3 : 1	7.68	0.01
HPH-7	100	25	75	3 : 1	0.00	1.00
HPH-8	100	28	72	3 : 1	0.48	0.49
HPH-9	100	24	76	3 : 1	0.05	0.82
HPH-10	100	32	68	Deviating from 3 : 1	2.61	0.11
HPH-11	100	27	73	3 : 1	0.21	0.64
HPH-12	100	34	66	Deviating from 3 : 1	4.32	0.04
HPH-13	100	26	74	3 : 1	0.05	0.82
HPH-14	100	33	67	Deviating from 3 : 1	3.41	0.06
HPH-15	100	22	78	3 : 1	0.48	0.49
HPH-16	100	26	74	3 : 1	0.05	0.82
HPH-17	100	34	66	Deviating from 3 : 1	4.32	0.04
HPH-18	100	30	70	3 : 1	1.33	0.25
HPH-19	100	42	58	Deviating from 3 : 1	15.41	0.00
HPH-20	100	23	77	3 : 1	0.21	0.64
HPH-21	100	36	64	3 : 1	0.05	0.82
HPH-22	100	33	67	3 : 1	0.21	0.64
HPH-23	100	28	72	3 : 1	0.48	0.49
HPH-24	100	21	79	3 : 1	0.85	0.36
HPH-25	100	37	63	Deviating from 3 : 1	7.68	0.01
HPH-26	100	34	66	3 : 1	0.05	0.82
HPH-27	100	32	68	Deviating from 3 : 1	2.61	0.11
HPH-28	100	30	70	3 : 1	1.33	0.25
HPH-29	100	24	76	3 : 1	0.05	0.82
HPH-30	100	27	73	3 : 1	0.21	0.64
HPH-31	100	25	75	3 : 1	0.00	1.00
HPH-32	100	26	74	3 : 1	0.05	0.82
HPH-33	100	29	71	3 : 1	0.85	0.36

Results on segregation of male sterile and male fertile plants revealed that male sterility expression is strictly under the control of single recessive gene and there is no involvement of modifiers. This is because, good fit (based on monogenic control) was observedin all the 33 population, which were very small in size (Table 1). Thus, possible involvement of modifier gene(s) in the expression may be precluded in the nuclear background of parents of 9 F1 hybrids (Deviated from expected ratio of 3:1). This suggestion may be further supported by the fact that male sterility expression in CCA-4261 line is highly stable and absolute (complete). In Capsicum, majority of nuclear male sterile lines have been reported to be highly stable , as per Beckett J B (1) and Huang W (4), however, few unstable male sterile lines have also been reported as per Kumar, S (5). Therefore, the deviation observed in 9 F2 populations could be because of presence of modifiers gene in the male parent of those crosses.

CONCLUSION

Heterosis plays an important role in improving crop yield, quality, and tolerance to disease and stress, demonstrating the importance of the development and utilization of male sterility. Recessive genetic male sterility shows advantages of many fertility restorer lines as well as successful crosses available for utilization of heterosis, but it is difficult to breed a specific line that can completely stable restorer. The novel genetic restorer germplasm bred in this study and showed normal fertilization with other inbred lines. Thus, the novel genetic restorer trait can be transferred to pepper lines and can combine with agronomic characters through backcrossing, which can be used to develop efficient hybrid seed production.

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REFERENCES

1. Beckett J B (1971). Classification of male sterility systems in mainze. *Crop Sci.* 11: 724-727
2. Chase, C. D. Cytoplasmic male sterility: a windo to the world of plant mitochondrial nuclear interactions. *Trends Gen*. 23:81-90 (2007).
3. Gulyas, G., Pakozdi, K,. Lee, J. S. and Hirata, Y. Analysis of fertility restoration by using cytoplasmic male sterile red pepper lines. *Breeding Sci*. 56: 331-334 (2006).
4. Huang W. (2015). Maintaining and Restoring CMS systems in Peppers. *Genetics and Molecular Research* 14: 3318-3329.
5. Kumar, S., Singh, V., Singh, M., Rai, S. K., Kumar, S. and Rai, M. Genetics and distribution of fertility restoration associated RAPD markers in inbreads of pepper. *Sci. Hort*. 111.197-202 (2007)
6. Singh, T. K., Kumar, S., Singh, M., Singh, G. and Rai, M. Characterization of recombinant inbread lines of *Capsicum annuum*. Veg Sci. 33:201-202 (2006).
7. Tembhurne, B. V. and Rao, S.K. Identification of fertility restorer and sterility maintainer lines in chilli. Indian Society for Sci. 21: 68-7 (2012).