DEVELOPMENT OF WHITE RUST RESISTANT, YELLOW SEEDED, ZERO ERUCIC ACID INDIAN MUSTARD (BRASSICA JUNCEA)

A.S. Khalatkar(1), G. Rakow(2), R.K. Downey(2)

(1) Department of Botany, Nagpur University Campus Nagpur 440 010, India
(2) Agriculture Canada Research Station, 107 Science Crescent, Saskatoon, Canada S7N 0X2

INTRODUCTION

Indian mustard (Brassica juncea Coss) is widely grown on the Indian subcontinent as an oilseed crop. Plant breeding work in Indian mustard is directed towards the development of higher yielding, white rust resistant varieties to increase and stabilize production and to reduce the country's dependency on imported vegetable oil for human consumption. However, seed quality improvements are also important and need to be addressed by plant breeders. The development of zero erucic acid, low glucosinolate (canola quality) varieties would greatly improve the general acceptability of mustard oil for food uses and enable the use of the meal as a protein food stuff in animal rations. The introduction of yellow seeded varieties would be of particular importance because yellow seeded forms have higher seed oil and higher meal protein and lower meal crude fibre contents than brown seeded forms. However, all mustard varieties presently grown in India such as Varuna, Pusa bold, Pusa burani and Seeta are fully susceptible to white rust. The oil obtained from seeds of these varieties is high in erucic acid (44 to 48% of total fatty acids), and the meal has high glucosinolate contents (115 to 200 µmoles of total aliphatic glucosinolate per 1 g oilfree meal). Their seed oil content is low (35 to 38%, dry matter basis) in comparison to that of B. napus varieties (42 to 45%).

The objective of this study is to develop adapted high yielding, white rust resistant varieties of Indian mustard for production in the mustard growing areas of India that are yellow seeded and produce high oil content seed with zero erucic acid oil.

MATERIALS AND METHODS

The Indian B. juncea variety Pusa bold will be used as the recurrent parent in a backcross breeding program with line ZYR-4. Pusa bold is well adapted to growing conditions in India and high yielding but is susceptible to white rust, brown seeded and high in erucic acid. ZYR-4, developed at the Agriculture Canada Research Station, Saskatoon is white rust resistant, yellow seeded and low in erucic acid.

Plants of Pusa bold and ZYR-4 were grown in pots in the greenhouse and reciprocally crossed during the summer of 1989. F_1 seeds from these crosses were also grown in the greenhouse, and the plants selfed. Individual F_2 seeds were analyzed by the half seed technique (Thies 1971) and zero erucic acid half seeds selected and transplanted into pots in the greenhouse . The zero erucic acid F_2 plants were sprayed with a zoospore suspension of Albungo candida race 2 at the two-leaf stage of growth in a

growth chamber (Tiwari et al. 1988). The plants were inoculated a second time one week after the first inoculation and white rust resistant plants identified two weeks after the second spray treatment. These plants were self pollinated and selfed F_3 seed harvested for field evaluation in India during the 1990/91 growing season.

RESULTS AND DISCUSSION

F_2 seed from reciprocal crosses between Pusa bold and ZYR-4 segregated in a 1:15 ratio of zero erucic acid to high erucic acid seeds indicating digenic control of erucic acid in mustard. The F_2 progeny of preselected zero erucic acid F_2 seeds segregated in a 3:1 ratio of white rust resistant to susceptible plants indicating monogenic control with dominance of resistance. The observed F_2 segregation pattern for erucic acid and white rust are in agreement with those reported by Kirk and Hurlstone (1983) for erucic acid and by Tiwari et al. (1988) for white rust. It is thus feasible to select for both characteristics in the F_2 generation and to advance only the zero erucic acid, white rust resistant F_2 segregants for further evaluation. Selections for yellow seed and high oil content will be conducted among zero erucic acid, white rust resistant F_3 progenies before a backcross to Pusa bold is carried out.

It has been found that B. juncea forms belonging to the China/East Europe geographical group have a strong long day photoperiodic requirement for flower initiation. When grown under short day photoperiodic conditions in India, these forms are very late flowering and maturing and therefore are agronomically unacceptable. In contrast, Indian mustard varieties of B. juncea flower and mature early under the short day regime. However, the development of "quality" B. juncea mustard requires the use of European forms in a crossing program with Indian varieties since the quality characteristics such as zero erucic acid, yellow seed and high oil content and also the white rust resistance characteristic have only been developed in European forms.

ACKNOWLEDGEMENTS

One of us (A.S. Khalatkar) is a Research Associate of CIDA/NSERC and would like to thank CIDA/NSERC and the Director, Research Station, Agriculture Canada, Saskatoon for financial assistance and the use of laboratory and green house/growth room facilities.

REFERENCES

KIRK, J.T.O. and HURLSTONE, C.J. 1982. Variation and inheritance of erucic acid content in Brassica juncea. Z. Pflanzenzüchtg. 90: 331-338.

THIES, W. 1971. Schnelle und einfache Analysen der Fettsäurezusammensetzung in einzelnen Raps-Kotyledonen. I. Gaschromatographische und papierchromatographische Methoden. Z. Pflanzenzuchtg. 65: 181-202.

TIWARI, A.S., PETRIE, G.A. and DOWNEY, R.K. 1988. Inheritance of resistance to Albugo candida race 2 in mustard (Brassica juncea (L.) Czern.). Can. J. Plant Sci. 68:297-300.