# Utilization of Indigenous Crab Apples for the Management of Foliar and Soil Borne Diseases

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**Abstract**

**The indigenous crab apples distributed through out the Himalayan region constitute different *Malus* species. These wild apples have been collected from the various parts of the India and evaluated for resistance against foliar and soil borne diseases such as apple scab, powdery mildew, Marssonina blotch, Alternaria leaf spots, white root rot and seedling blight. Different *Malus baccata* strains have shown different level of resistance against various diseases. *Malus baccata* Shillong has been found most promising which in addition to desirable horticultural traits possess high level of resistance for powdery mildew (*Podosphaera leuchotricha*), tolerance to white root rot (*Dematophora necatrix)* and high degree of resistance to woolly aphid (*Eriosoma lanigerum*). It has shown field resistance to apple scab (*Venturia inaequalis*) and Marssonina blotch (*Marssonina coronaria*). Similarly, *Malus orientale*, *M. baccata mandschurica* and *M. robusta* have shown minimum internal bark rotting against seedling blight (*Sclerotium rolfsii*). Further, the shoot and root segments of *M. simcoe, M. orientale* and *M. baccata* Kharot have shown least susceptibility to root rot fungus (*D. necatrix*). These species are being utilized as root stock for raising plants of delicious and spur type varieties of apple suitable for high density plantations.**

**Key Words** : Crab apple, *Malus baccata, Podosphaera leuchotricha, Dematophora necatrix, Venturia inaequalis, Marssonina coronaria,* disease resistance

## Introduction

Temperate fruits comprising pome and stone fruits, nut crops, kiwi, strawberry and blue berry contribute towards production of 117.7 million tons in the world and the share of India is 1.7 per cent. In India total area occupied by temperate fruits is 388900 ha which accounts for a total production of 19, 61,600 t. The per cent share of area in the world is 2.4 and that of production is 1.7. The average productivity of temperate fruits in world is 7.4 t/ha in comparison to 5.0 t/ha in India. Among the temperate fruits apple accounts for the highest production. Apple dominates the fruit industry of the State and at present (2003-04) covers an area of 84,112 hectares, which constitutes about 47% of the total area under fruits and 72% of the area under temperate fruits. The average productivity is very low in comparison to other countries In apples, the highest productivity of 10.3 t/ha was found in J & K followed by 6.3 t/ha in H.P. and 1.1 t/ha in UA. In walnuts, the highest productivity of 1.36 t/ha was recorded in J.& K in comparison to 0.5 t/ha in UA and 0.25 t/ha in H.P ( Kishore *et al*., 2006). The main causes for the fluctuating productivity are production related problems, nursery management, attack of pest and diseases, post harvest related constraints plantation of old traditional varieties, low planting density on seedling rootstocks, old and senile orchards etc.

Amongst diseases, premature leaf fall, apple scab, canker diseases, replant problem are of serious concern and which cause considerable losses. The current pest control strategy is based on use of chemicals, which is not cost effective, in some cases e.g. soil borne diseases it is practically impossible and moreover is proving damaging to the fragile natural ecology of the State. Further, there is a lack of possibilities for mechanization of plant protection operations due to the difficult terrain. Therefore, the wild apples collected from the various parts of the India were evaluated for resistance against foliar and soil borne diseases such as apple scab, powdery mildew, Marssonina blotch, Alternaria leaf spots, white root rot and seedling blight to find out the resistant or tolerant strains which can be utilized as rootstocks for susceptible varieties.

## Materials and methods

A large number of crab apples have been collected from the Himalayan region of India and established at this Regional Station, of the Institute. The efforts are being made to utilize the established gene bank for development of rootstocks for apple varieties. The existing genotypes have been evaluated for resistance to various biotic and abiotic stresses under field and laboratory conditions. The evaluation against foliar diseases such as, apple scab (*Venturia inaequalis*), Alternaria leaf spot (*Alternaria mali*), Marssonina blotch (*Marssonina coronaria*), powdery mildew (*Podosphaera leuchotricha)* have been carried out under field conditions by following standard protocols whereas for soil borne diseases a special techniques have been developed and genotypes have been evaluated both under *in vitro* and field conditions. For laboratory evaluation against *D. necatrix*, the dormant excised shoot segments (ten cm long) were washed with distilled water; air dried and surface disinfected with mercuric chloride(0.1% for one minute) and subjected to vacuum in order to remove trapped air between the bud scales. The 5mm portion of these segments was further excised from both the ends to eliminate any residual effect of the disinfectant. Surface sterilized pieces were again washed three times with sterile water before putting in specially prepared culture jars. The glass jars (12 cm long and 5cm diameter) were half filled with rough sand, supplemented with 50 ml potato dextrose broth and autoclaved at 15 lbs for 30 min. Each jar was inoculated with 20 spawn grains of *D. necatrix* (Sharma, 1993). These jars were closed and incubated at 22±1 °C for 7 days. Control jars were kept without culture. Subsequently, four pieces of shoot/ root segments were placed vertically in each jar and incubated at 22±1 °C for 2 weeks. Each treatment was replicated three times. The segments were taken out and the observations on the extent of mycelial growth and necrotic lesions induced by infection on each segment were measured.

Similarly, for evaluation against *S. rolfsii*, the prepared twigs (as described above) were placed in sterilized Petri plates lined with double layer of blotting paper and inoculated with mycelial bits (7mm) of vigorously growing culture of *S. rolfsii*. The inoculated plated were incubated at 28 °C and lined blotting paper was kept moist by watering them daily. The observations were taken after 10 days and internal and external bark rotting was measured.

## Results and discussion

Apple genotypes evaluated against foliar diseases showed the severe attack of *Alternaria* leaf spot followed by *Marssonina* blotch, scab and powdery mildew diseases. The genotypes *M. baccata* Shillong, *M. baccata* Kharot, *M. baccata* Dhak were moderately resistant to Alternaria leaf spot., whereas M. baccata Dhak and M. baccata Srinagar were moderately resistant to Marssonina blotch, however, none of the genotypes showed resistant reaction against any of these two diseases (Table-1). *Malus baccata* Shillong and *M. baccata* Srinagar also showed resistant reaction to scab and powdery mildew. All the commercial cultivars viz. Red Delicious, Royal Delicious, Rich-a-Red, Golden Delicious and Red Gold are highly susceptible to Marssonina blotch, however, cultivars TEW, Winter Delicious and Granny Smith are moderately resistant to this disease under field conditions (Bala *et al.*, 2001; Sharma, 2003). Cultivar McIntosh, EC 38729, EC 38730 were moderately resistant to powdery mildew, whereas *Malus baccata*, *M. pumila*, M9, MM106, and MM 111 were susceptible. All the commercial cultivars of apple were highly susceptible (Verma and Gupta, 1988). High nitrogen increase susceptibility of apple cultivars to scab whereas K increases resistance (Kumar and Gupta, 1986).

The shoot segments also showed the mycelial growth. The bark on twigs and roots turned dark brown followed by drying and blackening. It is evident from the Fig. 1 that shoot segments of *M. simcoe*, *M. baccata* Khrot and *M. orientale* have minimum mycelial growth and necrosis where as growth was maximum on M-27 followed by *M. baccata* Shillong. Ram (1982) evaluated the wild apple germplasm collected from Himachal Pradesh, Kashmir and North-East, for resistance to *Dematophora necatrix* and reported that *Cydonia oblongata*, *M. baccata* Japan, *M. baccata* Khrot, *M. floribunda*, *Prunus persica*, *Prunus cornuta*, *Prunus cerasoides* and *Pyrus pashia* var. kumabni

survived in an infected field for 6 years. The cultural filtrate of *D. necatrix* are toxic to apple seedlings and *in vitro* testing of rootstocks for resistance against cultural filtrate revealed that M9, MM101 and 102 were less susceptible whereas Rus Pippin was resistant (Gupta and Singh, 1985, Gupta and Verma, 1978).

The shoot segments inoculated with *S. rolfsii* preceded mycelial growth on bark followed by rotting and development of sclerotia in susceptible genotypes. The genotypes M-7, *M orientale*, MM106, *M. baccata mandschurica* and *M. robusta* showed minimum internal bark rotting as compared to others, however, none of them was completely resistant (Fig. 2). Earlier Bhardwaj, (1987) reported that out of 15 rootstocks evaluated against the pathogen three have been found resistant and two moderately resistant.

**Table 1. Response of indigenous apple genotypes to different diseases**

| Species | Alternaria leaf spot | Marssonina blotch | Powdery Mildew | Apple Scab | White root rot | Seedling blight |
|---|---|---|---|---|---|---|
| M7 | S | - | - | - | S | S |
| M 9 | - | - | S | S | S | - |
| M-26 | S | - | - | S | S | - |
| MM 106 | S | - | S | S | S | S |
| M.b.Shillong | MR | - | R | R | S | - |
| M.b. Khrot | MR | S | S | R | MR | MR |
| M.b. Giabung | - | - | S | - | S | - |
| M.b. Dhak | MR | MR | S | S | S | - |
| M.b. Srinagar | S | MR | R | R | S | - |
| M.b. Himalaica | - | - | S | - | - | - |
| M.b. Rohru | S | S | - | - | S | S |
| *M. sikkimensis* | - | - | - | R | S | - |

- = Not evaluated

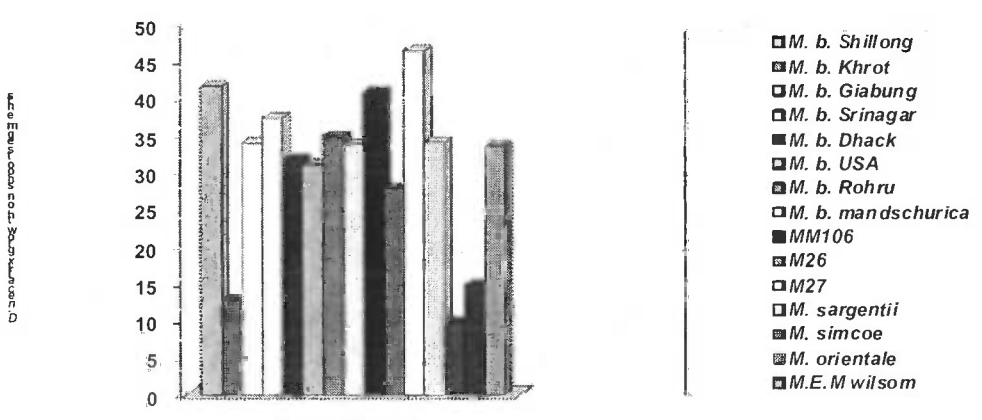


**Fig.1. Response of different *Malus* spp. / rootstocks shoots to *D. necatrix***

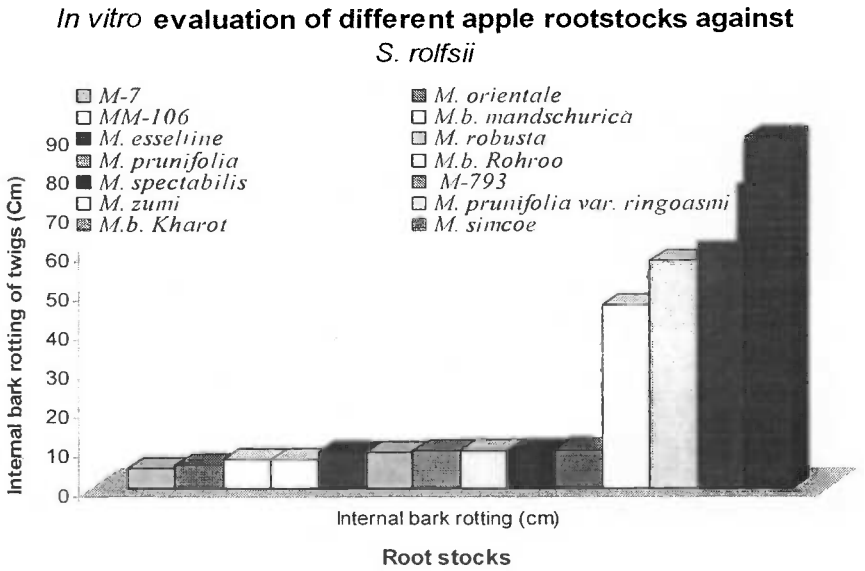


**Fig. 2. Response of different *Malus* spp. / rootstocks shoots to *S. rolfsii***

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