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Performance of Some Grafted Eggplant Genotypes on Wild *Solanum* Root Stocks Against Root-Knot Nematode

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Abstract: The study was carried out to identify resistant rootstocks of *Solanum* species for grafting of cultivated eggplant varieties against root-knot nematode and to evaluate the grafting compatibility of eggplant varieties with wild *Solanum* root-stocks. Three experiments were conducted in this respect. Six wild *Solanum* root-stocks were screened against root-knot nematode (*Meloidogyne incognita*). The root-stocks *Solanum torvum* and *Solanum sisymbriifolium* showed resistant reaction against root knot nematode. Fourteen varieties/genotypes were screened against root-knot nematode among which six varieties/genotypes showed resistant reaction. Three cultivated eggplant varieties viz., Sufala, Singnath and Kazla were grafted on *Solanum torvum* and *Solanum sisymbriifolium*. The highest grafting success was 95% in case of *Solanum torvum* with Sufala and the lowest (85%) in *Solanum sisymbriifolium* with Singnath. The success of grafting was not affected significantly due to the effect of scion and or of root stocks. The grafted plants showed resistant reaction against the disease while the scion plants showed susceptibility in the sick beds. The grafted plants also showed resistant reaction against the disease in the field conditions. The grafted plants also outyielded compared to the scion plants. The grafting combination *Solanum torvum* with Sufala gave the highest yield compared to other grafting combinations and non-grafted plants.

Key words: Grafted eggplant *Solanum*, root-knot nematode

Introduction

Eggplant (*Solanum melongena* L.) is the most important and widely consumed vegetable in Bangladesh grown round the year. It belongs to the family Solanaceae. The yield potential of eggplant is low in Bangladesh compared to other countries. Among the causes of low yield, incidence of various diseases, especially root-knot nematode is the main constrain to produce eggplant crops. Root-knot nematode caused by *Meloidogyne incognita* is another widely distributed important disease in the country (Ahmed and Hossain, 1985; Page, 1986; Mian, 1986). The disease is expressed by gall formation in the root system and ultimately the plant becomes weak due to interruption in nutrient uptake from the soil, at severe infection the plants may die. Resistant varieties of eggplant are not available in the country. There are two traditional methods to control the soil borne diseases; 1) soil sterilization by chemicals, which is very expensive and not practical and 2) use of resistant variety. Synthetic nematicides are not easily available to the farmers of Bangladesh and their application is not popular due to prohibitive high cost The only effective method to control the disease is the use of resistant cultivars. A number of wild relatives of *Solanum* were resistant to root knot nematode. These root stocks are graft compatible to eggplant. (Mochizuki and Yamakawa, 1979a,b; Ali *et al.*, 1990, 1990a,b, 1992; Shetty and Reddy, 1985). Recent reports from Bangladesh indicate that grafting of eggplant on resistant root stocks like wild *Solanum* is an effective technique to control root-knot disease (Islam, 1992; Ali *et al.*, 1994). To strengthen grafting technology, selection of rootstocks resistant to root- knot and efficacy for grafted eggplant against the root knot nematode disease is urgently necessary. Therefore, the present investigation was undertaken to identify the resistant rootstocks against root-knot nematode and to evaluate the grafting compatibility among the resistant rootstocks and cultivated eggplant varieties and also to determine the yield performance of the grafted plants in field condition.

Materials and Methods

Three field experiments were conducted at the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur during the period of August 1999 to May 2000 to evaluate the resistance of wild and cultivated *Solanum* species against rootknot nematode and the potentiality of wild *Solanum* as root-stock of eggplant.

Experiment 1

Reaction of wild *Solanum* and cultivated eggplant varieties/genotypes against root-knot nematode: Six wild *Solanum* species and fourteen cultivated eggplant varieties/genotypes were included in this study (Table 1). Seeds of six *Solanum* species and twenty one cultivated eggplant varieties/genotypes were sown in nursery beds on August 01, 1999. Before sowing the seeds were treated with GA_3 solution (100ppm) for 24h at room temperature for quick germination. Ten days after seed germination young seedlings were transferred to 9cm (dia) plastic pots containing sterilized soil mixed with 50% organic matter (v/v). For inoculation preparation, mature eggmass of nematode (*M. incognita*) were collected from severely galled roots of eggplants using fine forceps. After thorough rinsing with sterile distilled water the eggmasses were transferred to 75mm (diameter) petridishes containing 10ml sterilized distilled water and were incubated at $28 \pm 1°C$ for four days. Inoculum suspension of freshly hatched larvae was prepared in distilled water having about 500 larvae per ml. Inoculation was done by powering the inoculum containing 1000 nematode suspended in 2ml of water into two depressions made on the surface of the soil near the root system of seedlings. Ten plants of each entry were inoculated. Inoculated seedlings were allowed to grow for 30 days providing irrigation with fertilizer. The plants were arranged at the nursery bed following completely randomized. Sixty days old seedlings were uprooted carefully with minimum root damage. The roots were washed with running tap water and the number of galls per gram root were counted. Five observations were taken from each entry. The entries were graded following standard scale (Shetty and Reddy, 1985).

Experiment 2

Graft compatibility of eggplant varieties on wild *Solanum* species: Two wild *Solanum* species namely *Solanum torvum* and *Solanum sisymbriifolium* were used as rootstocks and three cultivated eggplant varieties Sufala, Singnath and Kazla were used as the scion varieties. Seeds of the two wild *Solanum* species were sown in plastic tray containing sandy soil on 1 August, 1999.

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Seedlings were transferred to 9 cm dia plastic pots containing soil and well decomposed compost in equal proportion ten days after germination. Seeds of the eggplant varieties were sown in plastic tray containing sandy soil and well decomposed cow dung on 10 August, 1999. Seedlings were transferred to 9 cm dia polybag 10 days after germination. All care were taken for proper growth of the seedling. Fourty to fifty days old rootstock seedlings (3- 4 leaf stage) and seedlings of eggplant varieties at 3-4 leaf stage were grafted. Grafting was done following the steps laid down by Ali *et al*. (1994).

Experiment 3

Evaluation of grafted plants in the sickbed: Inoculum suspension of freshly hatched larvae was prepared in distilled water having about 500 larvae per ml. Inoculation was done by powering the inoculum containing 1000 nematode suspended in 2 ml of water into two depressions made on the surface of the soil near the root system of seedlings. Ten plants of each grafted combinations were inoculated. Inoculated grafted plants were allowed to grow for 30 days providing irrigation with fertilizer. The grafted plants were planted at the nursery bed following completely randomized design. After sixty days, grafted were uprooted carefully with minimum root damage. The roots were washed with running tap water and the number of galls per gram root were counted. Five observations were taken from each grafted combinations. The grafted combinations were graded following standard scale (Shetty and Reddy, 1985).

Experiment 4

Yield potentiality and disease reaction of the grafted plants in field condition: The grafted plants were transplanted in field on 10 September 1999. The experiment was laid out in randomized complete block design. Twelve plants were planted per replication on a 1m wide bed at a spacing of 70 cm. The fruit yield per hectare was calculated from per plant yield and also recorded no. of galls per g root from infected plants. Manures and fertilizers were applied @ cow dung 15 tons, urea 250 kg, triple super phosphate (TSP) 175 kg and muriate of potash (MP) 150 kg ha^{-1}. The entire cow dung, TSP and half of the MP were applied during final land preparation while the entire urea and half of MP were applied at three equal installments as top-dressing. First and second top dressing were done 15 and 30 days after transplanted respectively and the third dose after first harvest of fruits. Data in respect of mortality of plants and fruit yield were recorded duly and analyzed statistically for interpretation.

Results and Discussion

Experiment 1

Reaction of wild *Solanum* and cultivated eggplant varieties/genotypes against root-knot nematode: It was revealed from data that eggplant genotypes BL 118 and BL S_{18} showed resistant reaction while Islampui and ISD 0011 were moderately resistant against root-knot nematode (Table 1). The varieties/genotypes BL 009, BL 099, BL S2, BL 114, BL 045, BL 081, BL 072, Singnath Sufala and Uttara were susceptible to root-knot nematode. Among the six wild species *S. sisymbriifolium* and *S. torvum* gave resistant reaction and *Solanum khasianum* moderately resistant reaction to root-knot nematode and the rest were found susceptible to root-knot nematode. Yamakawa and Mochizuki (1978) and Ali *et al*. (1992) also reported *S. torvum* as resistant to root-knot nematode. Shetty and Reddy (1985) also reported that *Solanum torvum* and *S. seaforthianum* showed resistant reaction against root-knot nematode.

Experiment 2

Graft compatibility of eggplant varieties on wild *Solanum* species: The results indicated that highest 96.21% grafting success was recorded in *S. torvum* grafted with Sufala (Table 2). It showed 96.21% grafting which is followed by *S. sisymbriifolium* grafted with Sufala (92.52%). Grafting success was the lowest in *S. sisymbriifolium* grafted with Singnath (87.65%). There was no significant difference in grafting success among the four graft combinations. Ali (1993) observed 70-95% success of grafting when eggplants were grafted on non-tuberous wild *Solanum* which is similar with the results of the this study.

Table 1: Reaction of wild *Solanum* and eggplant varieties/genotypes against root-knot nematode

Wild *Solanum* spp. and eggplant varieties/genotypes	No. of gall/g root	Grading
BL009	53.33	S
Sufala	43.00	S
BL S_2	34.33	S
BL 118	8.00	R
BL 114	43.00	S
BL S_{18}	12.67	R
Singnath	33.00	S
Uttara	62.67	S
Islampuri	28.67	MR
BL045	67.00	S
BL081	81.00	S
ISD0011	17.33	MR
BL 099	58.67	S
BL072	60.68	S
S. sanitwongsci	45.40	S
S. sisymbriifolium	6.40	R
S. integrifolium	54.40	S
S. indicum	54.30	S
S. torvum	10.00	R
S. khasianum	27.00	MR

Table 2: Grafting success of eggplant varieties with wild solanum rootstocks

Eggplant varieties	Solanum rootstocks		
	S. torvum	*S. sisymbriifolium*	Mean(%)
Sufala	96.21	92.52	94.37
Singnath	91.42	88.32	89.87
Kazla	90.85	87.65	89.25
Mean(%)	92.83	89.50	91.16

Table 3: Reaction of grafted and non-grafted rootstock in the sick beds

Treatments	No. of gall/g root	Grading/ reaction
S. torvum x Singnath	14.35	R
S. torvum x Sufala	12.80	R
S. torvum x Kazla	10.80	R
S. sisymbriifolium x Singnath	9.50	R
S. sisymbriifolium x Sufala	8.40	R
S. sisymbriifolium x Kazla	11.62	R
Singnath (non-grafted)	44.38	S
Sufala (non-grafted)	55.67	S
Kazla (non-grafted)	45.56	S

R = Resistant, MR = Moderately resistant, S = Susceptible, HS = Highly susceptible

Experiment 3

Evaluation of grafted plants planted in sickbed: Among the grafted and non grafted eggplants studied in the root-knot nematode sick bed, the highest number of galls per gram root was observed in non-grafted Sufala which is followed by Singnath and Kazla. In the sick plot all the grafted plants were showed resistant to root knot nematode with some mortality. There was 55.67% mortality of Sufala, Singnath (44.38%) and Uttara (45.56%) were found susceptible and moderately susceptible, respectively (Table 3). Mochizuki Yamakawa (1979b) reported *S. torvum* showed potential for use as rootstock. He also obtained good fruit yield scion varieties grafted on *S. torvum*.

Table 4: Yield potentiality of eggplant varieties when grafted on different *Solanum* rootstocks

Treatments	First flower opening	No. of fruits/ plant	Fruit yield/ plant (kg)	Fruit yield ton/ha	Duration of harvest	No. of gall/g root
S. torvum x Singnath	74.0a	38.7b	3.8ab	35.3b-d	132.0bc	10.40
S. sisymbriifolium x Singnath	68.47b	37.0bc	3.7b	33.3d	128.0bc	6.42
S. torvum x Sufala	67.0b	54.0a	4.2a	39.2a	140.7a	7.80
S. sisymbriifolium x Sufala	66.0bc	51.0a	4.1a	38.0ab	135.2b	5.56
S. torvum x Kazla	68.86bc	52.0a	4.1ab	36.5a-c	136.5b	6.20
S. sisymbriifolium x Kazla	65.57cd	54.7a	4.1ab	36.4cd	133.4bc	7.92
Singnath	62.0d	24.0e	2.1e	13.4f	122.4d	36.20
Sufala	60.56d	32.0cd	2.4de	15.6f	124.7cd	40.62
Kazla	54.0e	30.0d	2.6d	21.4e	120.3d	39.42
CV(%)	6.56	3.94	5.32	7.36	4.20	

In a column, means having a common letters do not differ significantly at 5% level of significance.

Experiment 4

Yield potentiality and disease reaction of the grafted plants in field condition: Plants of all eggplants varieties, grafted and non-grafted started flowering within 54-75 days after seed sowing (Table 4). It was generally observed that non-grafted plants bloomed earlier than grafted ones. Flowering was late in Singnath grafted with *S. torvum* and *S. sisymbriifolium* which was followed by Sufala and Kazla when grafted with wild *Solanum*. Kazla grafted on *S. torvum* and *S. sisymbriifolium* bloomed earlier than Sufala and Singnath grafted on *S. torvum* and *S. sisymbriifolium*. The earliest anthesis was observed in non-grafted Kazla, Sufala and Singnath which was statistically identical. The delayed flowering in grafted plants may be due to the growth of scion plants was interrupted or slowed down for a week nearly due to grafting. Similar trend of delayed flowering in grafted plants were also reported by Matsuzoe *et al*. (1990) and Ali *et al*. (1994). Among the studied scion varieties, the highest number of fruits per plant was recorded in 'Sufala' (32) which was statistically significant. The lowest number of fruits per plant was recorded in Singnath (24) which was statistically different from Sufala (32) and Kazla (30). However, Sufala and Kazla were statistically identical in this regard. Significantly higher number of fruits were recorded in grafted plants. Among the grafted plants on different root stocks, the highest number of fruits per plant was obtained in *S. torvum* x Sufala (54) followed by *S. torvum* x Kazla (52) and *S. sisymbriifolium* x Sufala (51), *S. torvum* x Singnath (38.7) and *S. sisymbriifolium* x Singnath (33.3). Among the scion varieties studied Kazla was the highest yielder (2.6 kg/plant) followed by Sufala (2.4 kg/plant) and Singnath (2.1 kg/plant) (Table 4). Grafting eggplant on *Solanum* rootstock significantly increased the fruit yield per plant. Sufala grafted on *S. torvum* gave the highest yield (4.2 kg/plant) followed by Uttara grafted on *S. torvum* (4.1 kg/plant), Sufala grafted on *S. sisymbriifolium* (4.1 kg/plant), Singnath grafted on *S. torvum* (3.8 kg/plant), Singnath grafted on *S. sisymbriifolium* (4.1 kg/plant) and Kazla grafted on *S. sisymbriifolium* (3.7 kg/plant) and they were statistically identical in this respect. Matsuzoe *et al*. (1990) and Ali (1993) also reported higher fruit yields in eggplant when grafted on *Solanum* rootstock. Similar trend was observed in respect of yield per ha also. It was revealed from the results (Table 4) that the duration of fruit harvest was significantly longer in grafted plants than those of non-grafted plants. The highest duration of harvest was recorded in Sufala when grafted on *S. torvum* which was significantly longer compared with those of all other grafted and non-grafted treatments.

It was revealed from the results that grafted plants showed resistance against root-knot nematode. Whereas, the non-grafted plants showed vulnerability against this disease at different levels. The highest number of galls/g root was recorded in the scion variety Sufala (40.62 galls/g root) followed by Singnath (36.20 galls/g root) and Kazla (39.42 galls/g root) respectively. Ali (1993) also reported the similar result.

The result of the observation exhibited that it could be recommended that eggplant could be grafted on *S. torvum* and *S. sisymbriifolium* for controlling root knot nematode and for higher yield. However, further refinement of the technology is required particularly in respect of age of rootstocks and scion seedlings for grafting and the management of grafted seedlings immediately after grafting.

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