Varietal Screening of Eggplant for Resistance to Bacterial Wilt, Fruit and Shoot Borer, Leafhopper (jassids) and Root-knot Nematode

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Abstract

Evaluation of the selected eggplant varieties produced very promising results this year. Four eggplant lines showed resistant reactions to bacterial wilt disease, and seven to root-knot nematode. Eleven eggplant varieties/lines exhibited high to moderate resistance to fruit and shoot borer (FSB) consistently for two years under both natural and artificial infestation conditions. Antibiosis and antixenosis tests strongly indicated that these varieties are genetically resistant to FSB. The selected FSB-resistant varieties include two cultivated varieties, Kazla and Uttara, which if cultivated widely can minimize FSB infestation effectively and will ultimately reduce pesticide use at the field level. These varieties have also some degree of resistance to jassids, aphid and white fly. Several of them have cross resistance to bacterial wilt and root-knot nematode. Identification of these resistant materials have enhanced the process of producing pest-resistant varieties.

Objectives

To confirm the reactions of bacterial wilt (BW) resistant eggplant varieties selected last year and search for new sources of wilt resistance;

To confirm the performance of previously selected fruit and shoot borer (FSB) and jassid resistant eggplant varieties and identify new resistant sources; and

To confirm root-knot nematode (RKN) resistance in eggplant cultivars previously identified at BARI, including the eggplant varieties commonly cultivated in Bangladesh.

IPM Constraints

Eggplant varieties grown by the farmers are seriously damaged every year by FSB, BW, jassids and RKN. Farmers use pesticides indiscriminately without knowing the pest, or gaining any satisfactory control of the pests. Previous research indicates that genetic resistance to these pests in eggplant varieties is available and the resistance can be introgressed into cultivated varieties through breeding. Use of resistant eggplant varieties will significantly reduce pesticide use and help produce healthy vegetables without significant yield losses.

Research Method

All the experiments were carried out at BARI farm, Gazipur during the 2001-2002 winter season, starting from November to April.

Eggplant resistance to bacterial wilt:
Three-week old seedlings of 37 selected eggplant varieties were planted at 20 cm spacing in one-meter long rows, 30 cm apart, in three replications in separate BW-sickbeds, which contained bacterial population *(Ralstonia solanacearum)* of 10^8 cfu/gm of soil. Each row served as a replication containing 10 plants. Observations were taken weekly and the reactions of the test varieties were graded based on percent of wilted plants.

Eggplant resistance to root-knot nematode:
One-month old seedlings of 34 eggplant varieties were planted at 15 cm spacing in one meter rows having 20 cm gap between rows in three replications in RCB design in separate RKN-infested sickbeds, which contained 4500-5000 RKN larvae per kg of soil. Sixty to 65 days after planting, the eggplants were uprooted with intact roots and washed in running water to record their shoot height and weight, and root length and weight, and the number of galls was determined. The galling intensity (gall index) was graded on a 0 to 10 scale, 0 representing roots with no galls and 10 for roots having severe galling. The reactions of the varieties were classified as highly resistant (HR), resistant (R), moderately resistant (MR), susceptible (S), and highly susceptible (HS).

Field trial for eggplant resistance to fruit and shoot borer, jassids, aphid and white fly:
One-month old seedlings of 29 selected eggplant varieties were planted 50 cm apart in 7 meter long rows in three replications laid out in RCB design. Each row separated by 70 cm represented a replication and contained 10 plants of each variety. Standard cultural practices and fertilizer rates were applied without taking any pest control measures. Weekly observations were made for pest infestations.

Microplot test for eggplant resistance to FSB with artificial infestation: One month old seedlings of 25 eggplant varieties /lines were transplanted in three replications in 3x3m plots. There were two sets of such plantings. All the plots were

covered, along the sides and the top, with 2-meter high fine-mesh nylon nets after 15 days of planting. Sixty days after planting, each plot of one set of the planting was infested with 10 pairs of equally sexed freshly emerged FSB adults of Jessore population, and the other with the Gazipur population. FSB populations of these two areas were earlier mass-reared in the greenhouse. Fifteen days before the artificial infestation, all the plants in each plot were cleaned and freed from all arthropods by sanitation and insecticide applications. The total number of healthy and infested eggplant shoots per plant in each plot was recorded 15 days after FSB adult release and the percent of shoot infestation was calculated.

Antibiosis and antixenosis tests for eggplant resistance to FSB:

The tests were conducted in a temperature-controlled greenhouse at BARI with 15 eggplant varieties selected earlier as resistant to FSB. An exotic variety, EG-075, served as susceptible check.

Antibiosis test: Twenty-day old seedlings of 15 selected eggplant varieties were planted in four replications in earthen pots at the rate of two seedlings per pot. Four weeks after planting, seedlings of each pot were infested with two first instar FSB larvae per plant. Ten days after infestation, the seedlings were dissected to record the number and weight of the surviving larvae.

Antixenosis test: Twenty-day old seedlings of 15 selected eggplant varieties were planted in a circular manner in 90cmx75cmx15cm steel trays containing manured soil. There were three plants for each variety in each of four replications. Four weeks after planting, a counted number of mature FSB eggs (at the rate of 5 eggs per plant) taken in a petri dish was placed at the center of the circular planting so that the hatched larvae can move and infest the plants of their choice. The number of infested plants of each variety was recorded 10 days after egg placement.

Results

Eggplant resistance to bacterial wilt:

The bulk of the 37 test entries was susceptible; only four lines showed some degree of resistance. The selected lines were: 'Mixture', SOO-141(I), BL-156 (III), and LG Long II (Table 1). The line 'Mixture' was found to be resistant in earlier tests. Review of last three year's results shows that eggplant resistance to bacterial wilt is low and scarce. However, low resistance can also play significant role in the context of IPM.

Table 1. Bacterial wilt resistant eggplant lines selected from sickbed screening, BARI farm, 2001-2002 winter season.

Lines	Bacterial wilt (%)	Disease reaction
Mixture	10	Resistant
BL-156 (III)	30	Mod. resistant
LG Long II	30	Mod. resistant
SOO-141 (I)	40	Mod. resistant

Resistant= 0-20% wilting; Moderately resistant= 21-50% wilting; Moderately susceptible= 51-70% wilting; Susceptible= 71-100% wilting.

Resistance of eggplant to RKN:

The bulk of the 34 test entries was susceptible. The gall indices varied from 2.9 to 7.0, and only seven entries having gall index below 5 showed moderate resistance to RKN (Table 2). Among the selected ones, BL-102 showed consistent resistance.

Table 2. RKN-resistant eggplant varieties selected from sickbed test, BARI farm, 2001-2002 winter season.

Varieties	Gall index (0-10 scale)	Disease reaction
BL-102	2.9	Mod. resistant
BL-97	2.9	Mod. resistant
BL-009	3.1	Mod. resistant
BL-156(II)	3.1	Mod. resistant
BL-122	3.1	Mod. resistant
BL-156(III)	3.9	Mod. resistant
BL-S1(S)1	4.0	Mod. resistant

Table 3. Eggplant varieties showing resistance to FSB in field trial, BARI farm, Gazipur, 2001–2002 winter season.

Varieites/ lines	Fruit infestation rate (%)	
	2000-2001	2001-2002
BL-107	0.4 (HR)	0.2 (HR)
EG-195	0.8 (HR)	0.7 (HR)
TS-060B	0.0 (HR)	0.9 (HR)
BL-072	13.4 (MR)	0.9 (HR)
BL-095(2)	12.6 (MR)	0.7 (HR)
BL-009	8.4 (R)	0.9 (HR)
BL-095	-	1.2 (R)
BL-114	14.5 (MR)	1.6 (R)
EG-203	0.5 (HR)	3.0 (R)
Kazla	3.9 (R)	7.1 (R)
Uttara	-	14.3 (MR)

HR= Highly resistant (<1% infestation); R= Resistant (<10% infestation); MR= Moderately resistant (<20% infestation). Data are averages of 3 replications.

Field resistance of eggplant to FSB, jassids, aphid and white fly:

Among 29 test entries, 6 were highly resistant (0.2 to 0.9% infestation), 3 were resistant (1.2 to 3.0% infestation), and 2 were moderately resistant (7 to 14% infestation) to FSB (Table 3). All of these varieties have been exhibiting resistance to FSB consistently from last year. The selected varieties include two cultivated varieties (Kazla and Uttara) which have moderate resistance. More importantly, these varieties have shown very low infestation of jassids, aphid and white fly, which are becoming increasingly important pests in recent years (Table 4). Resistance to a number of pests, as identified in these materials, is highly encouraging for developing multiple-resistant eggplant varieties.

Eggplant resistance to Jessore and Gazipur populations of FSB in microplots with artificial infestation:

The varieties/lines which showed resistance to FSB in field trials under natural infestation levels were also resistant in microplot tests subjected with artificial infestation. Little variation in the degree of resistance was, however, observed due to higher infestations effected from artificial confinement of the pest larvae (Table 5).

Table 4. Field reactions of promising resistant eggplant varieties to jassids, aphid and white fly, BARI farm, Gazipur, 2001-2002 winter season.

Varieties	Insect density (No./leaf)		
	Aphid	Jassid	White fly
BL—107	7.0	5.7	1.9
EG-195	5.1	2.2	1.1
TS-060B	7.6	7.0	1.7
BL-072	6.8	2.5	1.4
BL-095(2)	5.0	1.7	1.6
BL-009	4.7	2.5	1.0
BL-095	4.5	1.7	1.0
BL-114	3.8	1.3	1.0
EG-203	6.7	5.6	1.5
Kazla	5.8	1.5	1.2
Uttara	6.1	2.0	1.3

Data are averages of 3 replications.

Antibiosis and antixenosis tests for FSB resistance:

In the antibiosis test, the survival of the FSB larvae feeding on the resistant varieties varied from 6.7% to 21.3% as compared to 92.5% of the susceptible variety EG-075. Similarly, the body weight of the FSB larvae on the resistant varieties was much lower (0.019 g to 0.051g) than those feeding on the susceptible variety (0.094g). The lowest larval survival (6.7%) was recoded on the resistant line BL-009. This meant that the resistant varieties produced adverse effects on the biology of the FSB larvae while feeding on them. The antixenosis test showed that the resistant eggplant varieties were not preferred by the FSB as reflected from plant infestation rates. Plant (shoot) infestation varied from 9.8% to 83.3% in the resistant varieties as compared to 100% infestation in the susceptible check EG-075. The lowest infestations were recorded on BL-114 (5.8%) and BL-009 (9.8%), which had also lowest larval survival and body weight (Table 6). These tests amply indicate that the selected varieties possess genetic resistance to FSB and they can be used as resistant sources for developing improved, FSB-resistant varieties. Moreover, cultivation of the recommended varieties, Kazla and Uttara, can create positive impact on reducing FSB infestation and avoid or minimize insecticide use in eggplants.

Table 5. Reactions of promising resistant eggplant varieties in microplot test with artificial infestation of FSB, BARI farm, Summer season, 2002.

Varieties/lines	Shoot infestation (%) and reaction	
	Gazipur FSB	Jessore FSB
BL-107	8.3 (R)	5.7 (R)
EG-195	10.3 (R)	24.2 (MR)
TS-060B	6.7 (R)	25.3 (MR)
BL-072	3.3 (HR)	11.3 (R)
BL-095(2)	7.8 (R)	22.7 (MR)
BL-009	4.7 (HR)	10.3 (R)
BL-095	8.3 (R)	28.3 (MR)
BL-114	4.7 (HR)	12.7 (R)
EG-203	7.3 (R)	13.3 (R)
Kazla	7.3 (R)	21.7 (R)
Uttara	14.3 (R)	-

Data are averages of 4 replications. HR= Highly resistant (<5% infestation); R= Resistant (15% infestation); MR=Moderately resistant (<30% infestation); S= Susceptible (<50% infestation); HS= Highly susceptible (>50% infestation).

Table 6. Survival rates and body weights of FSB larvae feeding on selected resistant and susceptible (EG-075) eggplant varieties and plant infestation rates in antibiosis and antixenosis tests, BARI greenhouse, Summer season, 2002.

Varieties	Antibiosis test		Antixenosis test
	Larval survival (%)	Larval weight (g)	Plant infestation (%)
BL-107	21.3	0.034	24.3
EG-195	14.8	0.026	25.3
TS-060B	7.8	0.021	33.5
BL-072	7.8	0.029	14.8
BL-095(2)	8.8	0.028	18.3
BL-009	6.7	0.019	9.8
BL-095	8.3	0.017	26.3
BL-114	6.8	0.016	5.8
EG-203	17.8	0.043	50.0
Kazla	15.3	0.051	38.5
Uttara	19.3	0.048	83.3
EG-075	92.5	0.094	100.0

Impacts

The results have clearly shown that sources of resistance to the major pests and diseases are available in local and exotic eggplant varieties. Several of the eggplant varieties selected as resistant to FSB also possess resistance to some important insect pests, diseases and RKN. Moreover, the selected resistant varieties include two cultivated varieties which have potential to reduce FSB infestations and minimize insecticide use. Identification of these genetically resistant sources have enhanced the process of resistance breeding programs.

Project Highlights

Eleven eggplant varieties, selected as genetically resistant to fruit and shoot borer, have also some degree of resistance to jassids, aphid and white fly. Several of these selected materials also have resistance to bacterial wilt and root-knot nematode. Cultivation of two of the selected FSB-resistant varieties, Kazla and Uttara, has opened up opportunities for the farmers to produce relatively healthy eggplant crops with minimal or no pesticide use

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Demonstration and Pilot Production of Grafted Eggplant and Grafted Tomato and Training of Farmers

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Abstract

Grafting of cultivated eggplants or tomatoes was highly compatible producing more than 95% grafting success for both eggplants and tomatoes. Eggplant or tomato grafts suffered least mortalities from bacterial wilt or other diseases as compared to an overall 30% mortalities in the non-grafted ones. Pilot production of eggplant grafts in three locations was a tremendous success, producing about three times more yields and net income. Similarly, production of tomato grafts gave 145% increased yield and 140% more net income.

Objectives

To demonstrate and popularize eggplant and tomato grafting technology through pilot production; and

To disseminate eggplant grafting technology through training of farmers and nurserymen.

IPM Constraints

Bacterial wilt is a widespread serious disease of both eggplant and tomato in Bangladesh. In absence of any practical control methods, farmers use pesticides indiscriminately without any successful control of the disease. Grafting of cultivated eggplant and tomato varieties on BW-resistant eggplant rootstocks has been developed as a profitable alternative for production of healthy, pesticide-free eggplants and tomatoes.

Research Methods

Eggplant grafting:
About 15 thousand eggplant grafts were raised at BARI farm of Jessore and Gazipur for demonstration and pilot production at two intensive eggplant growing locations of Jessore (Gaidghat and Naodagagram), and one location of Gazipur (Sripur). Two cultivated varieties (variety Chega for Jessore, and variety Singnath for Sripur), which are susceptible to BW, were grafted on two BW-resistant wild eggplant rootstocks (*Solanum torvum* and *S. sisymbriifolium*) using the cleft grafting method. For grafting, 3-4 leaf stage seedlings (about 3-week old) of both the scion and rootstocks were used. The grafted plants along with the non-grafted scion varieties were transplanted 3-4 weeks after grafting in 13 farmer fields of two locations in Jessore and in one farmer field in Sripur. Fields of farmer practice (without grafted eggplants) served as the control. Standard cultural practices and recommended fertilizer doses were applied. No pest control measure was taken. The field demonstrations were carried out both in summer and winter seasons. Regular observations were taken on disease incidence and wilting of the plants. Data were also collected on plant height, fruit numbers per plant, fruit length and breadth, and yield.

Tomato grafting:
BARI Tomato- 2 and BARI Tomato-3, two BW-susceptible cultivated varieties, were used as scions for grafting on a BW-resistant wild eggplant rootstock (*Solanum torvum*). Several hundred tomato grafts were made using 35-day old seedlings of tomato scions and eggplant rootstocks. About 3-week old grafted tomato plants were transplanted along with the non-grafted tomato plants in a farmer field at Kashimpur site. Regular observations were made to record infections and mortalities from bacterial wilt disease. Data were