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Effect of farming conditions on bacterial wilt incidence in brinjal

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Abstract

Brinjal is one of the important vegetable crops on account of its medicinal value. Crop is vulnerable to plethora of diseases of which bacterial wilt is most devastating disease in the tropical, subtropical and temperate regions of the world, causing heavy economic loss. The chemical control of the disease is very expensive and the only way to sustain cultivation is by growing bacterial wilt resistant varieties. Of late, cultivated resistant varieties are gradually succumbing to the disease. Thus, the experiment was conducted to evaluate new bacterial wilt resistant lines (27) under mid hill conditions of Himachal Pradesh. The experiment was laid down under conventional farming and zero budget natural farming conditions. Observation was recorded on plant survival and the lines were categorized according to Sitaramiah scale (1981). The results indicated that BRBWRES-1, BRBWRES-2, SM 6-7, Hisar Shyamal, Arka Keshav, Arka Nidhi, Haritha, Muktakeshi and Kashi Prakash manifested no bacterial wilt incidence and were categorized as immune. Thus, these lines can be recommended for cultivation in bacterial wilt prone areas.

Keywords: Brinjal, bacterial wilt, zero budget natural farming, conventional farming

Introduction

Brinjal (*Solanum melongena* L.) is an economically important vegetable crop which has also been referred to as poor man's crop because it is an inexpensive but major food component of the human diet in the developing world (Prasad et al. 2015). Global productivity of brinjal 26.45 ton/ha (Anonymous 2013) is much higher than its productivity in India *i.e.* 17.54 ton/ha (Anonymous 2018). The major limiting factor resulting in low productivity is bacterial wilt caused by *Ralstonia solanacearum*. It has been reported to reduce brinjal production from 4.24 to 86.14% (Sabita et al. 2000) and may even lead to total crop failure. Chemical control of the disease involves high expenditure and is not very effective. Considering the economic losses incurred by the pathogen, the only alternative is to develop bacterial wilt resistant varieties possessing high yield potential along with other desirable horticultural traits. Varieties resistant to bacterial wilt like Pusa Purple Cluster, Pusa Anupam, Arka Nidhi, Arka Keshav, Hisar Shyamal, Pant Samart, Arka Neeelkanth, *etc*. have been recommended for cultivation in the state. But, these resistant varieties are gradually succumbing to the diseases. Therefore, it is essential to screen out some high yielding varieties and considerable degree of resistance. Keeping above said reasons in view, results of the experiment designed to screen bacterial wilt resistant lines for mid hill regions of Himachal Pradesh under conventional farming and zero budget natural farming conditions having desired horticultural traits and yield have been highlighted in this paper. Zero Budget Natural Farming is a unique method of farming which avoids use of plant protection chemicals. As people became aware of the harmful health and environmental effects of chemical pesticides and fertilizers, need for chemical residue free food was felt. So, Sir Albert Howard came up with the concept of organic farming. Organic produce is residue free and is environmentally sustainable, but it requires high monetary input and high organic manures and labor. Though human beings have been practicing organic farming since time immemorial but due to ill-effects of injudicious use of chemicals organic farming has gained new momentum and is gaining popularity amongst small and marginal farmers. The concept of Zero Budget Natural Farming is of recent origin. Padam Shri Subhash Palekar's Zero Budget Natural Farming is a unique method of farming which requires absolutely no monetary investment for purchase of key inputs like seeds, fertilizers and plant protection chemicals from the market. Since it is zero budget farming no institutional credit would be required and dependence on hired labour is also reduced to bare

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minimum (Babu 2013). It is based on the fact that as the crop takes only 1.5 to 2.0 % of nutrients from soil which are already available around the root zone of the plants in non-available form is converted to available form by the millions of micro-organisms, so the farming concentrates on increasing the soil microorganisms. In this farming dependence on hired labor is also very less as the system discourages inter-cultural operations. The whole philosophy behind this is to make the farmer self-reliant. A trial was also laid out in accordance with the principles of zero budget natural farming.

Materials and Methods

The experiment was conducted at the Vegetable Research Farm, Department of Vegetable Science and Floriculture, CSK HPKV, Palampur during *kharif,* 2016. The experimental farm is situated at an elevation of 1290.8 m above mean sea level with 32^0 6^2 N latitude and 76^0 32 E longitude. The location is characterized by humid and temperate climate with an annual rainfall of 2,500 mm of which 80% is received during June to September and represents the mid-hill zone of Himachal Pradesh. The soil is classified as Alfisols typic Hapludalf clay having a pH of 5.7. The experimental material comprised of 27 /lines of brinjal; procured from different sources all over the India including two resistant checks Arka Nidhi and Hisar Shyamal and one susceptible check Pusa Purple Long. The experimental material was laid out in randomized block design (RBD) with three replications under conventional farming conditions and two replications for evaluation of genotypes under zero budget natural farming. The inter-cultural operations were carried out as per recommended package of practices. In the zero-budget experiment *jeevamrutha* was applied as soil application @ 100ml per plant every fortnight. The plants were space planted at 60 cm inter row and 45 cm intra row. Number of plants that succumbed due to bacterial wilt was counted at 30, 60 and 90 days after transplanting and plant survival was calculated as below:

$$\text{Plant survival} = \frac{\text{Number of plants surviving in each entry}}{\text{Total number of plants in the entry}} \times 100$$

Lines were categories as resistant according to scale given by Sitaramiah in 1981 based on the plant survival. Plants were scored in relation to their resistance to bacterial wilt disease following the scale proposed by Sitaramiah et al. (1981) as detailed below:

Score	Infection (%)	Categories/grouping
1.	0 % plant wilted	Immune
2.	1 to 10 per cent plants wilted	Highly resistant
3.	11 to 50 per cent plants wilted	Moderately resistant
4.	51 to 70 per cent plants wilted	Moderately susceptible
5.	71 to 100 per cent plants wilted	Highly susceptible

conventional farming conditions. The cultivars Jawahar Brinjal-15, Pusa Shyamala and SM 6-6 under both the farming conditions, DRMKV-104-43, PB-67 and Surati Ravaiya Pink under conventional farming conditions and Debjhuri Hazari under zero budget natural farming conditions exhibited more than 10% but less than 50% wilt incidence and were classified as moderately resistant. Kumar et al. (2014) also classified SM 6-6 as moderately resistant. The cultivars classified as moderately susceptible *i.e.* exhibiting wilt incidence between 50-70 per cent were Pusa Bindu and RCMBL-49 under conventional farming conditions whereas, cultivars *viz*., DBR-8, DRMKV-104-43 and PB-67 were categorized as moderately susceptible under zero budget natural farming conditions.

Genotypes *viz*., Annamalai, Arka Kusumkar, Green Long, Gujarat Oblong, Kashi Taru, Pusa Purple Long and PLR-1 manifested 100% bacterial wilt incidence under both the farming conditions and were categorized as highly susceptible whereas, DBR-8 under conventional farming conditions and Pusa Bindu, RCMBL-49 and Surati Ravaiya Pink under zero budget natural farming conditions were classified as highly susceptible, as per the scale given by Sitaramaiah (1981). The results follow the findings of Ushamani and Peter (1987), Pathania et al. (1996), Singh and Gopalkrishnan (1998), Chaudhary and Sharma (2000), Gopalkrishnan and Reddy (2014) and Jhangta (2015).

The lines evaluated in the present study *viz*., BRBWRES-1 and BRBWRES-2 in the long group, SM 6-7 among the oblong type and Hisar Shyamal among the round type have been identified as the best performing lines under conventional farming conditions. All the four lines were found to be high yielding and resistant to bacterial wilt. These lines could be suggested for commercial cultivation in bacterial wilt prone areas. Under zero budget natural farming conditions, cultivars *viz*., BRBWRES-1 and BRBWRES-2 among the long fruited, SM 6-7 and Muktakeshi among the oblong type and H8 among the round type have been identified as resistant to bacterial wilt. These lines also performed well with respect to marketable fruit yield and yield contributing traits. Among the long-fruited SM 6-6 and Debjhuri Hazari also performed well but these were moderately resistant to bacterial wilt.

The experiment was conducted in bacterial wilt sick plots and bacterial wilt caused by *Ralstonia solanacearum* is a soil borne disease. The experimental site is characterized with heavy rainfall during June to September and soil is classified as acidic with a pH of 5.7 for both farming conditions. Popoola et al. (2014) found that cumulative number of rainy days has positive correlation with bacterial wilt incidence. Muthoni et al. (2014) reported the higher soil bacterial population in the third season of planting compared to the other two seasons that could be due to accumulation of bacterial population in the same piece of land over time due to cultivation in three consecutive seasons, high rainfall and temperature in that period or a combination of all factors. Qi et al. (1995), Li et al. (2017) observed that soil pH in ûelds infected by bacterial wilt was much lower than that in non-disease ûelds.

On comparing the mean values obtained in zero budget natural farming trial with the conventional farming trial an overall reduction in means was observed mainly in the marketable fruit yield per plant (Table 1). This might be due to the fact that microflora might not have established properly in the transition phase of field as the field was only used second time for natural farming and there was no waiting period given while conversion from conventional to natural field. More marketable fruit yield per plant in conventional trial could also be attributed to the use of chemical insecticides and pesticides to combat the insect and disease incidence. Yield reduction was also reported by Javeed (2012) in brinjal by using only liquid manures. Overall wilt incidence was also high which might be due to high concentration of inoculum in the natural farming field, but the resistant lines of conventional farming also remained resistant in the natural farming. Bacterial wilt incidence was found to be low with the application of NK (nitrogen and potassium) in potato (Siriri and Ebanyat 2001). Lemaga et al. (2005) reported that the application of N + phosphorus (P) + K and N + P (@100 kg/ha each fertilizer) reduced bacterial wilt by 29% and 50% in potato and increased the yield to 18.8 t/ha and 16.6 t/ha, respectively, which was higher than control (11.2 t/ha). Messiha et al. (2007) found that NPK fertilization reduced bacterial wilt (brown rot of potato) in conventional Egyptian soils. Yadessa et al. (2010) reported that farm yard manure (FYM) was found to be effective in suppressing bacterial wilt caused by *R. solanacearum* and in increasing the yield of tomato. Therefore, application of FYM and NPK might be one of the reasons for comparatively more plant survival and higher yield under conventional farming conditions than that of zero budget natural farming conditions. There was some degree of correspondence among the lines for marketable fruit yield per plant and component traits in both conventional and natural farming

Table 1: Plant survival rate of lines according to Sitaramiah Scale 1981 and marketable fruit yield per plant (kg)

Genotype	Plant survival at 30 DAT (%)		Plant survival at 60 DAT (%)		Plant survival at 90 DAT (%)		Marketable fruit yield per plant (kg)	
	Conventional farming conditions	Zero budget natural farming conditions	Conventional farming conditions	Zero budget natural farming conditions	Conventional farming conditions	Zero budget natural farming conditions	Conventional farming conditions	Zero budget natural farming conditions
Annamalai	70.83	31.25	12.50	6.25	4.17	0.00	0.02	0.05
Arka Keshav	100.00	100.00	100.00	100.00	100.00	100.00	0.62	0.12
Arka Kusumakar	62.50	25.00	8.33	0.00	0.00	0.00	0.02	0.01
BRBWRES-1	100.00	100.00	100.00	100.00	100.00	100.00	1.06	0.27
BRBWRES-2	100.00	100.00	100.00	100.00	100.00	100.00	0.91	0.20
BRBWRES-4	95.83	100.00	95.83	95.83	95.83	95.83	0.74	0.12
DBR-8	95.83	50.00	37.50	37.50	29.17	37.50	0.07	0.01
Debjhuri Hazari	100.00	81.25	95.83	50.00	95.83	50.00	0.76	0.32
DRMKV-104-43	91.67	81.25	75.00	56.25	66.67	43.75	0.37	0.05
Green Long	20.83	0.00	0.00	0.00	0.00	0.00	-	-
Gujarat Oblong	8.33	0.00	0.00	0.00	0.00	0.00	-	-
Haritha	100.00	100.00	100.00	100.00	100.00	100.00	0.31	0.07
Jawahar Brinjal-15	100.00	93.75	95.83	75.00	83.33	75.00	0.34	0.09
Kashi Prakash	100.00	100.00	100.00	100.00	100.00	100.00	0.14	0.02
Kashi Taru	58.33	0.00	0.00	0.00	0.00	0.00	-	-
Muktakeshi	100.00	100.00	100.00	100.00	100.00	100.00	0.50	0.17
PB-67	100.00	68.75	66.67	43.75	58.33	31.25	0.08	0.01
PLR 1	79.17	62.50	29.17	18.75	16.67	18.75	0.04	0.03
Pusa Bindu	75.00	56.25	37.50	12.50	37.50	6.25	0.08	0.02
Pusa Purple Long	41.67	0.00	0.00	0.00	0.00	0.00	0.02	-
Pusa Shyamala	95.83	87.50	87.50	56.25	62.50	56.25	0.49	0.07
RCMBL-49	95.83	56.25	70.83	25.00	33.33	18.75	0.38	0.03
SM 6-6	100.00	93.75	79.17	75.00	79.17	56.25	0.54	0.26
SM 6-7	100.00	100.00	100.00	100.00	100.00	100.00	0.86	0.17
Surati Ravaiya Pink	100.00	75.00	87.25	25.00	62.50	25.00	0.29	0.09
Arka Nidhi	100.00	100.00	100.00	100.00	100.00	100.00	0.76	0.15
Hisar Shyamal	100.00	100.00	100.00	100.00	100.00	100.00	0.76	0.15

Table 2: Categorization of lines according to Sitaramiah Scale 1981

Genotype	Fruit shape	Reaction	
		Conventional farming conditions	Zero budget natural farming conditions
Annamalai	Long	Highly susceptible	Highly susceptible
Arka Keshav	Long	Immune	Immune
Arka Kusumakar	Long	Highly susceptible	Highly susceptible
BRBWRES 1	Long	Immune	Immune
BRBWRES-2	Long	Immune	Immune
BRBWRES-4	Long	Highly resistant	Highly resistant
DBR-8	Round	Highly susceptible	Moderately susceptible
Debjhuri Hazari	Long	Highly resistant	Moderately resistant
DRMKV-104-43	Long	Moderately resistant	Moderately susceptible
Green Long	Long	Highly susceptible	Highly susceptible
Gujarat Oblong	Long	Highly susceptible	Highly susceptible
Haritha	Long	Immune	Immune
Jawahar Brinjal-15	Oblong	Moderately resistant	Moderately resistant
Kashi Prakash	Oblong	Immune	Immune
Kashi Taru	Long	Highly susceptible	Highly susceptible
Muktakeshi	Oblong	Immune	Immune
PB-67	Oblong	Moderately resistant	Moderately susceptible
PLR-1	Round	Highly susceptible	Highly susceptible
Pusa Bindu	Round	Moderately susceptible	Highly susceptible
Pusa Purple Long	Long	Highly susceptible	Highly susceptible
Pusa Shyamala	Long	Moderately resistant	Moderately resistant
RCMBL-49	Long	Moderately susceptible	Highly susceptible
SM 6-6	Long	Moderately resistant	Moderately resistant
SM 6-7	Oblong	Immune	Immune
Surati Ravaiya Pink	Round	Moderately resistant	Highly susceptible
Arka Nidhi	Long	Immune	Immune
Hisar Shyamal	Round	Immune	Immune

conditions, but the line Debjhuri Hazari performed exceptionally well in natural farming compared to the best performing line of conventional trial *i.e.* BRBWRES-1 and BRBWRES-2, thus more research on the performance of Debjhuri Hazari is required.

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औषधीय गुणों के आधार पर बैंगन को सब्जी फसलों में महत्वपूर्ण स्थान प्राप्त है। विश्व के उष्ण, उपोष्ण, समशीतोष्ण जलवायु क्षेत्रों में विनाशकारी जीवाणु उकठा रोग के प्रकोप से इस फसल को अधिक आर्थिक नुकसान होता है। नियंत्रण के लिए रसायनों का उपयोग ज्यादा महंगा होता है और ऐसी दशा में बैंगन की खेती करने के लिए मात्र जीवाणु प्रतिरोधी किस्मों को उगाने ही एक विकल्प है। खेती की जाने वाली प्रतिरोधी किस्में भी समय के साथ संवेदनशील होती जा रही है। जीवाणु उकठा रोग प्रतिरोधी 27 वंशक्रमों का मूल्यांकन हिमाचल प्रदेश के मध्य पर्वतीय क्षेत्रों में किया गया। पारम्परिक खेती एवं शून्य लागत वाली प्राकृतिक खेती की दशा में प्रयोग किया गया। पौधों को जीवित रहने की स्थिति का अवलोकन एवं आंकड़ें के आधार पर सीतारामैया (1981) द्वारा दी गयी पद्धति को अपनाकर समूहों में वर्गीकृत किया गया। परिणाम से स्पष्ट हुआ कि बीआरबीडब्ल्यूआरइएस–1, बीआरबीडब्ल्यूआरइएस–2, हिसार श्यामल, अर्का केशव, अर्का निधि, हरिता, मुक्त केशी, एम. काशी प्रकाश में जीवाणु उकठा रोग का प्रकोप नही पाया गया एवं इन्हें पूर्णतया प्रतिरोधी समूह में रखा गया। इस प्रकार इन चयनित वंशक्रमों को जीवाणु उकठा रोग ग्रसित क्षेत्रों में खेती के लिए अनुशंसा की जा सकती है।

References

Anonymous (2013) Food and Agriculture Organization Corporate Statistical Database, Rome.

Anonymous (2018) Handbook of Indian Horticulture Database, National Horticulture Board, Gurgaon.

Babu RY (2013) Action research report on Subhash Palekar's zero budget natural farming, p 1-7.

Chaudhary DR and Sharma SD (2000) Screening of some brinjal cultivars against bacterial wilt and fruit borer. Agricultural Science Digest 20: 129-130.

Gopalakrishnan C and Reddy MK (2014) Screening of brinjal genotypes for differential responses against bacterial wilt caused by *Ralstonia solanacearum.* Plant Disease Research 29:10.

Javeed UM (2012) Effect of organic and inorganic sources of nutrients on soil fertility and yield of brinjal (*Solanum melongena* L.). M.Sc. Thesis, Department of Soil Science. University of Agricultural Sciences, Dharwad, India, pp 55-57.

Jhangta M (2015) Genetic variability for fruit yield and horticultural traits in brinjal (*Solanum melongena* L.). M.Sc. Thesis, Department of Vegetable Science and Floriculture, CSK Himachal Pradesh KrishiVishvavidyalaya, Palampur, India. pp 92-95.

Kumar R, Kumari A, Singh AK and Maurya S (2014) Screening of bacterial wilt resistant accessions of brinjal for Jharkhand region of India. The Ecoscan 8:67-70.

Lemaga BR, Kassa KB, Ewell PT and Priou S (2005) Integrated control of potato bacterial wilt in eastern Africa: the experience of African highlands initiative, p. 145-158. In: C. Allen, P. Prior and A.C. Hayward (ed.), Bacterial Wilt Disease and the *Ralstonia solanacearum* Species Complex. American Phytopathological Society Press, St. Paul, MN.

Li S, Liu Y, Wang J, Yang L, Zhang S, Xu C and Ding W (2017) Soil acidiûcation aggravates the occurrence of bacterial wilt in South China. Frontiers in Microbiology 8: 703.

Messiha NAS, Bruggen AHCV, Diepeningen ADV, Vos OJD, Termorshuizen AJ, Tjou-Tam-Sin NNA and Janse JD (2007) Potato brown rot incidence and severity under different management and amendment regimes in different soil types. European Journal of Plant Pathology 119:367-381.

Muthoni J, Shimelis H, Melis R and Kinyua ZM (2014) Response of potato genotypes to bacterial wilt caused by *Ralstonia solanacearum* (Smith) (Yabuuchi et al.) in the tropical highlands. American Journal of Potato Research 91:215-232.

Pathania NK, Singh Y, Kalia P and Khar A (1996) Field evaluation of brinjal varieties against bacterial wilt (*Pseudomonas solanacearum* E.F. Smith.). Capsicum and Eggplant Newsletter 15:67-70.

Popoola AR, Ganiyu SA, Babalola OA, Ayo-John EI, Fajinmi AA, Kehinde IA and Adegboye TH (2014) Impact of soil amendments and weather factors on bacterial wilt and yield of two tomato cultivars in Abeokuta, Nigeria. South African Journal of Plant and Soil 31:195-201.

Prasad V, Dwivedi VK, Deshpande AA and Singh BK (2015) Genetic combining ability for yield and other economic traits in brinjal (*Solanum melongena* L.). Vegetable Science 42(2): 25-29.

Qi G, Ma G, Chen S, Lin C and Zhao X (1995) Microbial network and soil properties are changed in bacterial wilt susceptible soil. Applied and Environmental Microbiology Doi: 10.1128/AEM.00162-19.

Rahman MA, Ali F, Hossain KMA and Laila L (2011) Screening of different eggplant cultivars against wilt disease caused by fungi, bacteria and nematodes. Journal of Experimental Sciences 2:6-10.

Sabita JN, Boruah BM and Rachid HA (2000) Yield potentiality of some brinjal cultivars in severely bacterial wilt infected condition. Vegetable Science 27:76-77.

Singh PK and Gopalakrishnan TR (1998) Evaluation of brinjal genotypes for yield and bacterial wilt resistance. Journal of Applied Biology 8:70-74.

Siriri BLD and Ebanyat P (2001) Effect of soil amendments on bacterial wilt incidence and yield of potatoes in southwestern Uganda. African Crop Science Journal 9:267-278.

Sitaramiah K, Singh RS, Vishwakarma SN and Dubey GS (1981) Brinjal cultivars resistant to *Pseudomonas* wilt. Indian Phytopathology 34:113.

Ushamani P and Peter KV (1987) Field resistance of brinjal to bacterial wilt. Agricultural Research Journal of Kerala 25:133-135.

Yadessa GB, Bruggen AHCV and Ocho FL (2010) Effects of different soil amendments on bacterial wilt caused by *Ralstonia solanacearum* and on the yield of tomato. Journal of Plant Pathology 92:439-450.