

# SCREENING OF POTATO CLONES FOR FIELD RESISTANCE TO BACTERIAL WILT ( *Pseudomonas solanacearum* )

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## INTRODUCTION

Potato is one of the crops with high priority in the development of vegetable culture in Indonesia because it has the potential to improve farmers' income and standard of living. Centers of potato production in Indonesia are located in Lembang and Pangalengan (West Java), Wonosobo and Magelang (Central Java), Malang (East Java), and Berastagi (North Sumatra) from where the bulk of production is exported to Singapore and Malaysia.

Bacterial wilt caused by *Pseudomonas solanacearum* is a major disease of potato world-wide and one of the principal problems of potato production in tropical countries, such as Indonesia. Bacterial wilt is a soil-borne disease, and the genetically highly variable and therefore highly adaptive pathogen causing it has such a wide host range that chemical control is not feasible. The pathogen remains dormant in the soil for many years and can also be carried by seed tubers with latent infection. Clean fields can thus be infested unintentionally. One effective method to control bacterial wilt is the cultivation of resistant cultivars.

In order to develop new varieties with good levels of resistance to bacterial wilt as well as good agronomic characteristics and acceptable culinary traits, breeding for resistance to this disease has until recently continued at the International Potato Center (CIP) as well as various national potato research programs. CIP has produced a set of potentially bacterial wilt resistant potato clones which are currently field-tested in Indonesia's principal potato growing centers

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## **OBJECTIVES OF INDONESIAN FIELD TESTS**

The two major objectives of these field tests are:

1. to assess the field resistance of 18 potato clones from CIP, Lima, Peru to bacterial wilt in different agro-ecoregions of Indonesia, and
2. to assess the agronomic and yield characteristics of these clones in the field.

## **METHODS**

Eighteen potato clones from CIP were multiplied at the Research Institute for Vegetables in Lembang, Bandung, Indonesia and in farmers' fields at Cibodas, Lembang. Tubers from the second clonal generation of these clones were tested for their resistance to bacterial wilt at four locations in potato production centers in different agro-ecoregions. These locations were Lembang, West Java at an altitude of 1250 m above sea level (a.s.l). Pangalengan, West Java (1200 m a.s.l); Ngablak, Central Java (1400 m a.s.l) and Batu East Java (1000 m a.s.l).

The trials were started on February 13, 1996 at Lembang, February 15, 1996 at Pangalengan; February 10, 1996 at Ngablak, and February 14, 1996 at Batu. Prior to planting, bacterial populations in the soil of each site were estimated, using the dilution technique.

Thirty tubers of each clone were grown in a Randomized Complete Block design with three replications in 3m x 2.5m plots with a planting distance of 80cm x 30cm. Fertilizer was applied prior to planting at the rate of 30 t/ha in the form of animal manure, and 1000 kg/ha in the form of NPK fertilizer (Rustica yellow, 15:15:15). To control pests and fungal diseases, the fungicide Dithane (at the rate of 20 gr/l), and the pesticides Curacron (at the rate of 25 cc/l) and Marshal (at the rate of 25 cc/l) were applied weekly until the plants were 60 days old.

The plants were left to get naturally infected with the pathogen causing bacterial wilt. Incidence of wilt was observed on each clone in each location at 30, 45, and 60 days after planting. The crop was harvested 100 days after planting, and potentially bacterial wilt resistant clones with good agronomic performance were selected for further evaluation in multilocational yield trials.

## RESULTS AND DISCUSSION.

Laboratory analysis of soil samples showed that *Pseudomonas solanacearum* populations at the four trial sets varied significantly (Table 1). The highest bacterial population was found at Ngablak ( $5 \times 10^7$  CFU/kg soil) followed by Pangalengan ( $8 \times 10^6$  CFU/kg soil), Batu ( $2 \times 10^4$  CFU/kg soil) and Lembang ( $6 \times 10^3$  CFU/kg soil)

Table 1. *Pseudomonas solanacearum* population in the soils of the four trial sites, February 1996

Locations	Baterial Population (CFU/kg soil)
Ngablak	$5 \times 10^7$
Pangalengan	$8 \times 10^6$
Batu	$2 \times 10^4$
Lembang	$6 \times 10^3$

The highest rate of average wilt incidence at all sites was observed on clone 390805 (62.73%), while the lowest rate was observed on clone 390814 (19.05%). Granola, the control cultivar, had an average wilt incidence of 26.92%. For all clones, the highest degree of bacterial wilt incidence was found at Ngablak, Central Java, (53.52%), followed by Pangalengan, West Java, (49.06%), Batu, East Java (13.99%), and Lembang, West Java, (6.13%). Based on the overall data of bacterial wilt incidence at the four locations, clones 390814, 390791, 390774, and 390812 were rated as adequately resistant to bacterial wilt with 19.06%, 21.82%, 22.01%, and 22.20%, respectively. Six clones i.e, Granola, 390818, 390811, 390775, 390817 and 390785 were moderately resistant (26.92%, 27.58%, 28.10%, 28.36%, 28.84%, and 30.60%) while the other clones were moderately susceptible and susceptible with bacterial wilt incidence of more than 31%. A complete set of data is shown in Table 2.

Table 2. Percentage (%) of bacterial wilt incidence at four locations in Java. Wet season 1995/1996

No.	Clone No.	Wilt incidence (%) at				Mean
		Lembang	Pangalengan	Ngablak	Batu	
1	390774	-*	16.1	41.7	8.1	22.01
2	390775	1.6	39.9	58.2	13.5	28.36
3	390785	3.5	56.6	47.7	14.5	30.60
4	390786	8.4	54.4	59.9	4.5	31.82
5	390789	8.3	72.2	53.3	27.8	40.41
6	390791	4.3	25.3	43.3	14.7	21.91
7	390795	10.2	87.7	59.9	7.8	41.43
8	390805	-*	82.2	73.3	32.6	62.73
9	390811	2.5	47.7	49.9	12.2	28.10
10	390812	9.2	16.4	51.0	12.1	22.20
11	390814	0.8	19.7	15.1	4.5	19.05
12	390815	10.8	62.2	71.1	12.2	39.08
13	390816	11.6	61.1	48.8	29.3	37.74
14	390817	2.5	57.7	51.5	3.5	28.84
15	390818	6.7	24.8	58.3	20.4	27.58
16	390819	7.6	64.4	46.6	6.7	31.33
17	390820	16.6	63.3	40.3	5.9	31.54
18	390821	4.3	49.9	60.0	10.0	31.09
19	Klon J	3.9	37.7	54.4	27.2	30.83
20	Granola	9.3	41.0	45.5	11.7	26.92
Mean		6.12	49.04	53.32	13.99	

Note: \* -: Data are not available

The highest yield was observed in clone “J” (a nationally developed clone) with 312.33 g/plant. The highest yield of any of the CIP clones was obtained from clone 390811 (239.25 g/plant), followed by the five clones 390814 (232.08 g/plant), 390812 (229 g/plant), 390785 (222.08 g/plant), 390816 (220.66 g/plant) and 390815 (203.41 g/plant). The lowest yielding clone was number 390805 which still had 141.10 g/plant while check Granola yielded 244.75 g/plant.

The highest yield average of all sites was obtained at Ngablak, Central Java, (281.30 g/plant) which was followed by Batu, East Java (203.73 g/plant), Lembang, West Java (178.76 g/plant) and Pangalengan, West Java (113.26 g/plant). Complete yield data are shown in Table 3.

Table 3: Yields of bacterial wilt resistant clones in four locations in Indonesia (in g/plant).

No.	Clone No.	Location				Mean
		Lembang	Pangalengan	Ngablak	Batu	
1	390774	-*	141.3	229.3	180.3	183.66
2	390775	165.6	93.0	270.0	201.3	182.50
3	390785	252.0	76.0	317.3	242.3	222.08
4	390786	117.0	71.0	237.3	245.3	167.75
5	390789	177.0	70.0	307.3	157.3	178.00
6	390791	149.0	120.0	243.3	262.3	193.83
7	390795	141.3	76.0	266.0	225.0	177.16
8	390805	-*	41.0	203.0	178.6	141.10
9	390811	263.3	98.0	402.6	192.3	239.25
10	390812	256.6	205.3	278.6	185.3	229.00
11	390814	252.3	208.3	295.3	172.3	232.08
12	390815	151.6	108.3	343.6	210.0	203.41
13	390816	195.3	90.6	235.3	361.3	220.66
14	390817	204.6	85.6	257.0	142.0	172.33
15	390818	124.3	94.0	319.0	119.6	164.25
16	390819	166.0	92.3	248.6	203.3	177.58
17	390820	163.0	81.3	187.3	147.3	143.75
18	390821	161.0	82.3	251.0	230.6	181.00
19	Clone J	395.0	259.0	395.6	199.6	312.33
20	Granola	250.0	168.0	339.0	220.0	244.75
Mean		178.76	113.26	281.3	203.75	

Note: \*:- Data are not available

When comparing these yields with average yields in temperate climatic zones, it has to be realized that a yield of 300g/plant would translate to more than 20t/ha which is considered as highly acceptable under tropical highland and mid-elevation agro-ecological conditions. The average national yield of Indonesia is around 15 t/ha.

Based on bacterial wilt incidence, yield, uniformity of tubers and rate of marketable tubers, five clones, i.e. clones number 390811, 390814, 390785, 390791 and 390812, were selected for further trials. The harvested tubers will be checked for bacterial wilt (to prevent spread of the pathogen through latently infected tubers) by means of a ELISA/PCR test specifically designed for the detection of bacterial wilt. Clean tubers will then be used for rapid multiplication through stem cuttings.

## CONCLUSION

- Of 18 potentially bacterial wilt resistant CIP clones tested in field tests at four locations in Indonesia, where bacterial wilt is a constraint to potato production, the eight clones 390774, 390775, 390791, 390811, 390812, 390814, 390817, and 390818, were the most resistant with a wilt incidence of less than 30%.
- Six of these clones (390785, 390811, 390812, 390814, 390815 and 3908116) yielded on average more than 200 g/plant.
- Five clones were selected according to their rank in bacterial wilt infection, tuber yield, percentage of marketable tubers and tuber uniformity, and these five clones (390811, 390814, 390785, 390812 and 390791) will be evaluated further in multilocational yield trials in Indonesia.

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