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STUDIES ON THE EFFICACY OF VARIOUS SYSTEMIC FUNGICIDES AGAINST BEAN RUST, (Uromyces appendiculatus (Pers.) Lev.)

by

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Introduction

Following the conclusions drawn from last year's trials (Jaffer, 1971), it was decided to concentrate on further testing of the systemic fungicides this year in order to test their relative performance to reduce or control the bean (Phaseolus vulgaris L.) rust caused by the fungus Uromyces appendiculatus (Pers.) Lev.

According to the reports received from farmers to this office and from our visits to various seed beans growing areas around the region, it appears the incidence of the disease was rather on the high side compared to 1970 and 1971 seasons, and as such, crop losses due to this disease were also comparatively high.

This paper reports the results of three separate trials conducted from April to August 1972. In Trial 1, eight systemic fungicides were compared with standard treatment Plantvax and untreated control. In Trial 2 effect of Plantvax and Triforine used at reduced rate was tested and Trial 3 was carried out to see if a single spray instead of two usual sprays of both Plantvax and Triforine, would effectively control the disease.

TRIAL 1

Materials and Methods:

Beans, Phaseolus vulgaris L of the highly rust susceptible variety - Dutch Princes No. 200 were planted in the third week of April, 1972 in 5 x 6m square plots, containing 11 rows of 50 plants each, separated by a ½m guard row. A clear strip of 1m width was left between the blocks. Plant spacing were 50 cms. by 10 cms.

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Eight systemic fungicides namely - WL-24479, Topsin, Topsin-M, Bavistin, Calixin, Hoe-6052, S-805 and U-8342 were compared against Plantvax and untreated control, at the rates shown in Table 1. The active ingredients and the manufactures of the fungicides used are also indicated in the table.

The treatments were randomized and replicated four times. The fungicides were applied with 'Solo 425' knapsack sprayers when the first symptom of the disease appeared about a month after planting. A second spray was applied 10 days after the first one.

The disease was assessed thrice i.e. on the 7th, 14th and 21st day after the second spray, by scoring the rust on 9 leaflets per plant from ten plants in each plot. The surface area of each leaflet was about 18 cm^2.

Scoring on each leaflet was based on the following scale:-

0 = No rust

1 = Slightly rusted: 1-5 spots per leaflet

2 = Moderately rusted 6-15 " "

3 = Heavily rusted 15 or more spots per leaflet but 50% of leaf surface still green.

4 = 50% of the leaflet rusted

5 = No green tissue left.

The disease assessment was then determined by obtaining the mean scoring index for all of the observed leaflets in each plot. The mean scoring index in all plots per chemical treatment were further averaged to obtain the final mean scoring index for each chemical. The final mean scoring index x 20 was criterion of disease indices.

The yield in kg/plot and post harvest germination of bean seeds from different treatments was also assessed.

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Table 1. The rates of application of various systemic fungicides in the control of Bean rust (Uromyces appendiculatus)

Fungicides	Rate of application	Active ingredient	Manufacturers
WL-24479 50% WP	4kg/ha	5,6-Dihydro-N-(3,4-Methylenedioxyphenyl 2-methyl-4 H pyran-3 carboxamide	Shell
Topsin 50% WP	4kg/ha	1,2-Bis(3 Ethoxycarbonyl-2-thioureido benzene (Thiophanate)	Nippon Soda Co. Ltd.
Topsin-M 70% WP	2kg/ha	1,2-Bis (Methoxycarbonyl-2- thioureido benzene (Thiophanate Methyl)	Nippon Soda Co. Ltd.
Bavistin 50% WP (=Bas 3460 f)	1.5 kg/ha	2- (Methoxy-carbamoyl) benzimidazole (BCM)	BASF
Calixin 75% EC	1.41/ha	4-Tridecyl-2-dimethyl-morpholine (Tridemorph)	BASF
Hoe-6052 (= Pyracarbolid) 50% WP	4kg/ha	2-Methyl-5,6-dihydro-4--H-pyran-3 carboxylic acid aniline	HOECHST
S - 805	1000ppm S-805 + 2000ppm wetting agent	Identity not available	Gulf Research Kansas

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Table 1 Cont.

U-8342	1.1 kg/ha	-4-Amino-2 methyl -6-Chloro pyrimidine	Upjohn, Kalamazoo
Plantvax	3½ kg/ha	2,3-Dihydro-5- carboxanilido-6-methyl-1,4-oxathim 4,4-dioxide	Uni-Royal Chemicals

The Results

The results of the three disease assessments are summarised in Table 2.

Table 2. The effect of 9 systemic fungicides on the incidence of rust on bean (Phaseolus vulgaris L) leaves recorded as disease indices and assessed thrice at weekly intervals after the 2nd spray.

Treatments	DISEASE INDICES Mean 1st assessment 7 days after 2nd spray	Mean 2nd assessment 14 days after 2nd spray	Mean 3rd Assessment 21 days after 2nd spray	Yield kg/plot
WL-24479	25.50	43.25	69.75	4.41
Topsin	50.75	62.55	95.45	3.24
Topsin M	43.85	65.15	79.50	3.97
Bavistin	57.15	79.25	92.15	3.12
Calixin	41.80	64.45	90.85	3.81
Hoe-6052	5.20	11.75	18.80	5.21
S - 805	50.00	62.95	90.30	3.71
U - 8342	58.95	92.40	90.40	2.60
Plantvax	25.22	24.50	53.35	4.78
Control	60.10	85.25	91.30	3.63
F - test	significant	significant	significant	Not sig.
C.D. at: 5%	6.56	6.36	6.52	
1%	8.86	8.59	8.86	
0.1%	11.80	11.43	11.80	

Mean 1st, 2nd and 3rd assessment were done on 12/6; 19/6 and 26/6/72.

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Hoe-6052 gave excellent control of the rust followed by Plantvax. The rest of the treatments did not perform comparatively well. Incase of Hoe-6052 slight phytotoxicity was observed after the sprays. Compared to last two years performance of Plantvax (Hudson & Jaffer 1970, Jaffer 1971), the chemical gave rather poorer result this year. This could have been due to the fact that on the days when the first and second sprays were applied, there was a heavy rainfall few hours after the spray and probably the chemical was not absorbed rapidly enough resulting in part of chemical being washed out. This factor could possibly account for some chemicals which gave almost the same or worse results than the controls.

The mean yield of cleaned beans in terms of kg/plot did not show any statistical difference between the treated and the untreated plots. Neither did the post harvest germination percentage of different treatment show any suppression in germination.

The distribution of frequency of different rust rating was determined by recording the total number of leaflets in each chemical treatment under its particular rust rating. This was achieved as follows: the rust ra ting was made on 9 leaflets per plant from 10 plants in each plot as described earlier in this paper. Since there were, altogether, 4 plots (replicates) for each chemical treatment, there were, therefore, a total of 360 leaflets observed for each fungicide. Of these, the total number of leaflets observed for each rust rating was recorded. The results obtained are shown in Table 3. The first, second, and third assessments were done 7, 14 and 21 days respectively after the last spray.

A chemical with a good control on the bean rust shows a high number of leaflets in the low rust ratings; a good example is Hoe-6052. Plantvax also performs better than other fungicides while U-8342 and Bavistin give particularly poor results since the high number of leaflets are under high rust ratings. The performance of other chemical can be evaluated accordingly from Table 3.

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Table 3.

DISTRIBUTION OF RUST RATE FREQUENCIES IN TRIAL I.

Treatments	I st ASSESSMENT							II nd ASSESSMENT							III rd ASSESSMENT						
	Rust Rates							Rust Rates							Rust Rates						
	0	1	2	3	4	5	Total	0	1	2	3	4	5	Total	0	1	2	3	4	5	Total
WL-24479	104	119	75	50	9	0	360	3	68	183	71	22	3	360	0	0	83	113	70	94	360
Topsin	18	58	81	150	20	33	360	0	3	54	116	148	39	360	0	0	0	9	63	288	360
Topsin M	21	62	142	92	42	0	360	0	34	72	157	38	45	360	0	0	20	101	89	140	360
Bavistin	30	57	78	90	15	90	360	65	25	33	49	8	180	360	0	4	0	26	65	265	360
Calixin	6	66	184	80	9	9	360	0	23	67	138	69	53	360	3	6	0	39	91	221	360
Hoe 6052	276	73	11	0	0	0	360	189	139	20	12	0	0	0	177	90	58	15	11	9	360
S - 805	3	56	130	96	66	9	360	0	53	37	125	86	49	360	3	11	40	111	195	221	360
U - 8342	3	21	131	106	31	66	360	0	0	6	37	44	273	360	0	0	0	0	6	354	360
Plantvax	170	122	41	18	4	0	360	68	183	81	16	9	3	360	54	33	84	72	33	84	360
Control	15	10	75	147	81	32	360	0	3	18	62	74	203	360	0	9	9	27	33	282	360

TRIAL 2.

In this trial, the effect of Plantvax and Triforine, both sprayed at half the rates that were used in the last year experiment (Jaffer, 1971) were compared with the untreated control. The application rates in 1971, of Plantvax and Triforine were $3\frac{1}{3}$ kg/ha and 1000ml/ha respectively. In the present experiment, Plantvax and Triforine were applied at 1.5 kg/ha and 500ml/ha respectively. In 1971, Triforine was used as a 0.1% solution and as 0.05% solution in the present experiment.

Material and Method

The same rust susceptible variety as in Trial 1 above was planted during the third week of April. Plot design, size, and spacing were also similar as in Trial 1.

The first signs of the rust were seen about four weeks after planting. The first spray was then applied immediately after these first signs of the disease were observed. The second spray was applied 10 days after the first spray.

Assessment and rating were similar as those described above in Trial 1.

Results

Table 4 shows the result of three assessment. Both Plantvax and Triforine were significantly better than the untreated control at P = 0.01. Plantvax is slightly superior to Triforine. The mean yield of cleaned beans in terms of kg/plot did not show any statistical differences between the treated and the control plots. Neither did the post-harvest germination percentage on the treatments show any effect on germination.

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Table 4.

The effect of Plantvax and Triforine applied at ½ half rates of those that were applied in the previous year on the rust incidence. Disease assessment was done thrice at the weekly interval after the second (final) spray.

Fungicide	Mean 1st assessment	Mean 2nd assessment	Mean 3rd assessment	Mean yield in kg/plot
Plantvax	5.95	12.50	54.00	1.13
Triforine	12.10	20.95	63.80	1.02
Control	33.40	64.95	99.00	1.03
F - test	sig.	sig.	sig.	Not sig.
Critical Difference at 5%	5.08	7.24	11.50	
1%	7.71	10.97	17.42	
0.1%	12.39	17.63	28.00	

Mean 1st, 2nd and 3rd assessment were done on 12/6; 19/6; and 26/6/72 respectively.

Table 5 shows that all the fungicides reduced the rust incidence considerably when compared to unsprayed controls.

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Table 5.

DISTRIBUTION OF RUST RATE FREQUENCIES IN TRIAL 2.

Treatments	I st ASSESSMENT							II nd ASSESSMENT							III rd ASSESSMENT						
	Rust Rates							Rust Rates							Rust Rates						
	0	1	2	3	4	5	Total	0	1	2	3	4	5	Total	0	1	2	3	4	5	Total
Plantvax	273	66	21	0	0	0	360	96	157	80	27	0	0	360	30	6	68	30	31	195	360
Triforine	183	138	36	3	0	0	360	17	126	137	80	0	0	360	0	0	125	101	80	54	360
Control	27	136	127	58	12	0	360	0	3	43	199	94	21	360	0	0	0	0	18	342	360

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TRIAL 3.

The object of this experiment was to see whether a single spray as opposed to two usual sprays of Plantvax and Triforine would also give an adequate control of bean rust.

Materials and Methods:

The experimental procedure was similar to the one described in Trial 2.

A single spray of Plantvax and Triforine, at the rate of $3\frac{1}{3}$ kg/ha and .1% solution respectively, was applied when the first signs of the disease appeared- about 4 weeks after planting.

Assessments and disease ratings were also same as in Trial 1.

Results and Conclusion:

Results of three assessments of the rust carried out are summarized in Table 6. Both treatments were significantly better than control. Plantvax performed better than Triforine although there is no statistical difference between the performance of the two chemicals.

Table 6. Effect of Plantvax and Triforine applied as a single spray on the rust incidence and yield of beans (Phaseolus vulgaris)

Treatments	Mean 1st Assessment	Mean 2nd Assessment	Mean 3rd Assessment	Yield in kg/plot
Plantvax	9.95	12.50	39.00	0.78
Triforine	15.50	20.95	42.60	1.25
Control	33.60	64.95	99.50	0.54
F - test	Sig.	Sig.	Sig.	Not Sig.
C.D. at: 5%	7.56	7.46	10.47	
1%	11.45	11.30	15.86	
0.1%	18.41	18.17	25.50	

Mean 1st, 2nd and 3rd assessment were done on 12/5; 19/5; and 26/5/72 respectively.

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The mean yield of cleaned beans in terms of kg/plot did not show any statistical difference between the treated and untreated plots. Neither did the post-harvest germination percentage on the different treatment show any suppression in germination.

The distribution of frequency of different rust rates are shown in Table 7. Plantvax proves slightly superior, in the control of the bean rust than Triforine.

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Table 7.

Distribution of rust rate frequencies in trial 3.

Treatments	1st Assessment							2nd Assessment							3rd Assessment						
	Rust Rates							Rust Rates							Rust Rates						
	0	1	2	3	4	5	Total	0	1	2	3	4	5	Total	0	1	2	3	4	5	Total
Plantvax	213	116	28	3	-	-	360	97	156	80	27	-	-	360	18	106	137	81	9	9	360
Triforine	154	138	62	6	-	-	360	27	128	119	86	-	-	360	18	48	193	80	11	10	360
Control	33	110	137	77	3	-	360	-	3	44	198	94	21	360	-	-	-	-	9	351	360

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Conclusion.

Of the chemicals which have been tested in this Institute, Hoe-6052 (Pyracarbolid), Plantvax, and Triforine give the maximum reduction of bean leaf rust caused by the fungus Uromyces appendiculatus. Hoe-6052 is superior to Plantvax in the control of the rust. The performance of both Triforine and Plantvax is similar although Plantvax tends to give a better control of the rust than Triforine.

The work reported here indicates that reduction of leaf rust by the fungicides does not necessarily lead to a significant increase in the mean yield of cleaned beans in terms of kg/plot. However, the seed quality is enhanced in sprayed plants than in the control. Unlike the sprayed plants, the control plants yield seeds which appear reduced in size, with wrinkled surface and appearing slightly yellowish. Therefore, the effect of fungicides is to increase the quality rather than quantity of the seeds.

Disease incidence is reduced significantly when both Triforine and Plantvax are sprayed at half the recommended rates or when sprayed at one instead of the usual two intervals.

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