Relative efficiency of fungicides in the control of damping-off and Stemphylium leaf spot of broad bean (*Vicia faba* L.).

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ABSTRACT

This study -was carried out to compare the efficiency of some recently introduced, systemic and contact fungicides in the control of seedling damping-off and Stemphylium leaf spot of broad bean. The present work showed that damping-off of broad bean is mostly caused by a complex of some soil fungi, the disease was successfully controlled by seed dressing with Benlate thiram (4 g/kg seeds) and Brassicol (PCNB) at the same rate. Thus, higher seedling stands were produced by these treatments. Both fungicides as well as those known to have a systemic action were also recorded to reduce Stemphylium leaf spot incidence. Effect of different fungicides on plant growth, nodulation and yield was also investigated. Benlate T, Vitavax captan and Brassicol treated seeds gave longer roots and better nodulation. However, the two former fungicides only gave a significant increase in the seeds yield per plant. It was also shown that the combination of carboxin (*i.e.* Vitavax) and captan (*i.e.* Orthocide 83), in one compound namely; Vitavax captan was of super effect in damping-off control than each one separately.

Broad bean (*Vicia faba* L.) is the major annual leguminous crop in Egypt (A.R.E.). This crop is subjected to the attack of many diseases at various stages of plant growth which affect the root and the shoot systems (1, 2, 3, 4, 12, 18, 21). One of the serious diseases, is the seedling damping-off at pre- and post-emergence stages of seedling development. This disease almost caused a reduction in seedling stand which indirectly affects the total yield per cultivated area. Shoot system is frequently affected by the invasion of many pathogenic fungi, from which Stemphylium leaf spot was reported to cause severe necrosis to leaflets and subsequently causes premature defoliation (10).

Seed dressing treatments were employed for damping-off control by many investigators, whenever new fungicides were introduced to the country (13, 14, 23). Also, Stemphylium leaf spot was successfully controlled by foliar spray with some contact and systemic fungicides (15).

In a recent work carried out by the authors (11), it was found that some fungicides, particularly those of systemic action, could be used for the double purpose of damping-off control of cucurbit seedlings and thereafter on the powdery mildew at the latter stages of plant growth.

This work was therefore designed to test some of the recently introduced fungicides, either of contact or systemic action, on damping-off control and also their residual effect in mature plants as indicated by the incidence of Stemphylium leaf spot on broad bean plants.

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MATERIALS AND METHODS

Seeds of broad bean (variety Giza 2) were obtained from the Ministry of Agriculture, Orman, Giza.

Fungicides used:

1. Orthocide 83 (83% captan) Rhone Poulenc.
2. Brassicol (75% P C N B) Farbwerke Hoechst AG, Frankfurt, W. Germany.
3. Vitavax (75% carboxin) Uni Royal.
4. Vitavax captan (37.5% carboxin + 37.5% captan) Uni Royal.
5. Benlate T (50% benomyl + 30% thiram) Du Pont.
6. Milcol 40 (40% drazoxolon) I C I.
7. Homai 80 (50% thiopbanate M + 30% TMTD) NISSO.
8. Mancozan (80% mancozeb) Pepro.
9. Granosan (15% carbendazine + 60% maneb) Du Pont.

All fungicides were dressed on seeds using a sticker (0.5% starch),3 days before sowing. Rates of application are mentioned in the relevant section of this paper. Similar treatment with the omission of fungicides served as control.

Screening of different fungicides was carried out by sowing each set of dressed seeds in two replicate, 4m-long ridges, 50cm apart with 20 hills per ridge. Five seeds were planted per hill. Field experiment was planted on November in the experimental

farm of the College of Agriculture at Moshtohor, Qualubia. The experiment was designed in completely randomized blocks with 3 replicates (24). The experimental area was divided into subplots,1/400 feddan each (3.5 x 3.0 m). Seeds were sown in rows, 50 cm apart (**5** rows/plot) at the rate of 20 seeds per each row.

Readings for seedling stand were expressed as the number of survived seedlings after 10 and 30 days of sowing. Effect of fungicides on nodulation was recorded after 30 days of planting. Twenty replicate plants, taken at random from each treatment, were gently uprooted, washed by repeated soaking in tap water and the number of nodules per plant was counted. At the same age, 10 plants per plot were thinned by careful uprooting, then thoroughly washed in tap water and lengths of roots and shoots were estimated. Later on, roots were cut with scissors directly up to the juncture of the collapsed cotyledons. Both roots and shoots were dried separately in a hot-air oven at 70°C until a stable weight is reached. Readings for Stemphylium leaf spot were recorded 3 months after planting (age of host maximum susceptibility to the disease). Disease ratings suggested by Eisa (10) were employed for scoring disease severity. Disease indices were calculated according to the equation suggested by Townsend and Heuberger (26). At harvest time, yield of broad bean seeds was determined as the average weight of air-dried seeds per plant. Each reading was the average of 20 replicate plants taken at random from each plot.

RESULTS

Preliminary experiment:

Numerous specimens of naturally damped-off seedlings were frequently received or collected by the authors from Giza and Moshtohor locations. Isolations were made from diseased seedlings and the resulting fungi were tested for their pathogenicity on potted broad bean seedlings under green-house conditions using the routine pathological techniques.

Results showed that damping-off of broad bean almost results from *Rhizoctonia solani* (Kuhn), *Fusarium solani* (Mart.)Snyder and Hansen, and *Fusarium oxysporum*, where they were frequently isolated from diseased seedling. Identification of the causal fungi was done by comparing their cultural and morphological characteristics with the species description made by Gilman (17)and Toussoun and Nelson (25).

On this basis, seed dressing experiments presented in the respective section were made in naturally infested soil to control the fungus complex affecting broad bean seedlings. Stemphylium leaf spot lesions were easily recognized by their characteristic symptoms experienced by the authors. This was frequently verified by microscopical examination of numerous spotted leavescollected from the infested field.

A. Screening of different fungicides on the survival of broad bean seedlings

Results **(Table 1)** show that Homai 80, Benlate T, Mancozan and Brassicol were the most effective fungicides in reducing pre-emergence damping-off, thus producing high rate of survivals at day 10 of seed sowing. However, at day 30, best seedling stands were obtained from treatments of Vitavax captan, Benlate T, Homai 80 and Brassicol. Data also show a delayed germination in Vitavax captan, Orthocide 83 and Granosan treatments, thus percent survivals increased at day 30.

Table 1: Effect of different fungicides on seedling survival of broad bean.

Fungicides	Rate of application* (g or ml/kg seeds)	% Survived seedlings after 10	30 (days)
Milcol 40	2.0 ml	70.0	59.0
Brassicol	3.0 g	74.0	70.0
Homai 80	3.0 g	84.0	72.0
Mancozan	6.0 g	76.0	69.0
Orthocide 83	3.0 g	42.0	60.0
Granosan	3.0 g	64.0	68.0
Benlate T	3.0 g	78.0	74.0
Vitavax captan	3.0 g	42.0	76.0
Untreated (control)	0.0	64.0	62.0
L.S.D. at 0.05		7.6	6.8

* Most of the used rates were in the range suggested by the manufacturers and Ministry of Agriculture, A.R.E.

B. Effect of fungicides on plant growth and nodulation:-

Data presented in **Table 2** apparently show a significant effect of fungicide treatments on plant growth. This is clearly shown in the rate of elongation of roots and shoots. Brassicol, Vitavax captan and Benlate T were superior to the other

fungicides in enhancing growth of plant roots. This was **positively correlated with higher rates of root nodulation**, and dry weights of roots. Brassicol was also found to cayse a high increase in dry weight and length of the shoots as compared with other treatments. This particular increase could be interpreted by the great? enhancement of root nodulation produced by this fungicide. It is also apparent that most fungicides which do not affect root development could not also support good nodulation(Mancozan, Orthocide 83, and Granosan). No clear relationship was found between the rate of nodulation and the increase in shoots' dry weight at this early stage of plant growth.

C. Field experiment:-

In this experiment, some of the fungicides that proved to cause reduction in seedling damping-off, were further tested in a field experiment to insure their efficiency in the natural habitat. Their residual effect in the foliage, at latter stages of plant growth, was also recorded as indicated by their effect on Stemphylium leaf spot. It was also of interest to investigate whether the efficiency of Vitavax captan is due to the effect of Vitavax or to captan alone or to the combination of both chemicals.

Results in **Table 3** show that Benlate T (4 g/kg seeds) and Brassicol (4 g/kg seeds) were still of good effect in reducing seedling damping-off under field conditions, thus produced high seedling stands at day 30 of sowing.

Table 2 : Effect of fungicides on plant growth and nodulation.

Fungicides	Av. Length (cm) of/1		Av. Dry wt./plant(mg), /2		Nodulation/3
	Root	Shoot	Root	Shoot	
Milcol 40	6.7	29.4	205	1060	9.6
Brassicol	9.2	39.5	273	1521	31.8
Homai 80	7.8	32.6	213	1390	7.8
Mancozan	7.5	31.7	170	1308	1.4
Orthocide 83	7.9	25.3	200	989	0.5
Granosan	7.8	29.0	150	990	1.6
Benlate T	8.9	31.5	218	1075	18.7
Vitavax captan	8.9	31.9	222	1200	12.3
Untreated (control)	7.4	25.8	200	950	1.2
L.S.D. at0.05	1.1	5.6	21	49	4.8

1/ Each reading is the average of 20 replicate plants, 30 days-old taken at random.
2/ and 3/For explanation see "Materials and Methods".

Table 3: Effect of different fungicides on seedling survival, Stemphylium leaf spot and yield of broad bean *(Field experiment).*

Fungicides	Rate of application (g/kg seeds)	% survival after		Disease index%*	Av. Yield per plant(g)
		10	30 (days)		
Benlate T	**2**	64	60	10.14	14.40
	4	66	67	7.59	19.50
Vitavax	**2**	54	57	10.79	10.00
	4	60	58	12.55	17.00
Vitavax captan	**2**	63	62	10.34	11.40
	4	69	65	11.17	18.16
Orthocide 83	**2**	63	60	18.87	14.00
	4	63	60	20.30	16.60
Brassicol	**2**	66	63	11.32	14.16
	4	69	65	7.13	13.33
Untreated (control)	**0**	62	58	19.87	16.33
L.S.D at 0.05		2.1	3.7	2.30	1.03

* Readings for Stemphylium leafspot are taken after 3 months of planting.

It is also apparent that the combination of captan and carboxin in "Vitavax captan" has a significant effect in increasing seedling stand of broad bean under field conditions. However, either captan alone (Orthocide 83 treatments) or carboxin (Vitavax) were likely to be of insignificant value in improving seedling stand.

All the fungicides known to have a systemic action apparently reduced Stemphylium leaf spot incidence at 3 months of plant age. Brassicol also reduced disease incidence but this was probably due to the bigger foliage of the plants. Orthocide 83 was of no effect on the leaf spot incidence at the both rates employed.

Readings for the yield of seeds per plant are actually of approximate value as many factors might interfere in estimating the real yield obtained (e.g. birds and human damage). However, there was a significant higher yield in Benlate T and Vitavax captan treatments (4 g/kg seeds).

DISCUSSION

Broad bean (*Vicia faba* L.) was recorded in many countries to be subjected to the attack of many root and foliage diseases (1). In Egypt, this crop is known to be an important source of protein for the majority of the people, and so raising the productivity of the cultivated area seems to be an essential goal for those interested in crop production. One of the easy means for improving the productivity is the disease control at different stages of plant growth. Several investigations, published in the last two decades, were mostly interested in the control of soil-borne pathogens affecting seedling stand (2, 13, 14, 18, 21, 23), It was shown from the results of Crowdy (8) and of the authors (11) that some chemicals could be translocated from the roots to the foliage where they can possibly affect the establishment of foliar diseases. This gives a truly good and easy method for the control of both root and shoot diseases by the application of fungicides on seeds. In this work, some of the recently introduced fungicides (either new formulae or chemicals) were used for seed dressing. Their effect on seedling stand (as an indication for damping-off control) and Stemphylium leaf spot were recorded. The latter disease was particularly selected as it caused severe necrotic lesions on the leaves accompanied by a premature defoliation (10).

Data accumulated from this work in two tests showed that Benlate thiram (*i.e.* Benlate T) at the rate of 4 g/kg seeds and Brassicol at the same rate were effective in reducing damping-off incidence, thus producing higher seedling stands. These results are supported by the findings of other workers (20, 22). Both fungicides, as well as those of systemic effect were also recorded to have a beneficial effect in reducing Stemphylium leaf spot incidence (7). Orthocide 83 (*i.e.* 83% captan) was of no significant effect on the leaf spot disease. This may indicate its rapid decomposition in the soil before being translocated to the shoots, or to its weak effect on the causal fungus. However, the effect of Brassicol on Stemphylium leaf spot could be attributed to its high stability in the soil (5, 6), thus could be easily translocated by the root system to the foliage. This translocation was suggested to be passive and mostly related to transpiration (9).Benonyl (*i.e.* Benlate) was reported to be easily translocated and accumulated in the leaves, especially at the margins and the tips where it is released into the aerial parts (16, 19, 27).

One of the interesting results shown here, is the better effect of the combination of carboxin (*i.e.* Vitavax) and captan (Orthocide 83) in one compound namely Vitavax captan in controlling the damping-off complex than each one separately.

It was also found that the best fungicides used in damping-off control were also of beneficial effect in increasing root length which was positively related to nodulation. This was finally reflected on the yield which was significantly increased in Benlate T and Vitavax captan treatments. However, Brassicol-treated plots, although gave better plant growth at the early stages yet there was no clear improvement in the yield.

From this work it could be recommended with great safe the application of Benlate T at the rate of 4 g/kg broad bean seeds for the control of seedling damping-off and the reduction of Stemphylium leaf spot.

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