AGRICULTURE

EFFECTS OF POWDERY MILDEW ON YIELD, YIELD COMPONENTS AND SEED QUALITY OF MUNGBEANS

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Abstract

Powdery mildew caused by *Podosphaera phaseoli* (Zhao) U. Braun. is an important foliar disease of mungbeans. An experiment was conducted over two seasons to evaluate the loss due to the disease, using a split-plot design with the two main plots being with and without the application of fungicide. Five mungbean varieties and lines were in the sub-plots. Among these, one was highly resistant, one moderately resistant and three were susceptible to the disease. The experiment showed that powdery mildew reduced yield, seed weight per plant, seeds per plant, pods per plant and seed size by 26.21, 19.53, 33.22, 20.02, and 6.02 percent, respectively. It was also found that the disease caused the reduction of seed germination, seedling vigor and weight of bean sprout.

Keywords: Mungbean, powdery mildew, yield components, seed quality

Introduction

Powdery mildew caused by *Podosphaera phaseoli* (Zhao) U. Braun is an important fungal disease of mungbeans (*Vigna radiata* (L.) Wilczek). It has been reported in mungbeans in many subtropical and tropical countries including Australia, India, the Philippines, Korea, Thailand, Columbia, the USA etc. (Poehlman, 1991). The disease first appears on the leaves; in its advanced stage, stems and pods become infected, resulting in yield loss. The disease reduced yield of mungbeans by between 21 and 40 percent (Soria and Quebral, 1973) in the Phillippines and upto 40 percent in Taiwan (AVRDC, 1984). In Thailand, the disease has been found to infect mungbeans in the late rainy and dry seasons but the severest infection is in the cool dry months. The loss due to the disease in the country has not been thoroughly evaluated. The objective of this study was to investigate the effects of powdery mildew on yield, yield components and quality of seeds for propagation and for sprouting.

Meterials and Methods

The experiment was conducted at Suranaree University of Technology, Nakhon Ratchasima, Northeast Thailand during May 2001-November 2002. Five varieties and lines of mungbeans including SUT4 (highly resistant to powdery mildew), VC3689A (moderately resistant), Chainat 60, Chainat 36 and VC3476A

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(susceptible to powdery mildew) were used in the study. The experiment was conducted over two seasons: early rainy season (May - August, 2001) and dry cool season (Nov 2001 - February 2002) using a split-plot design with four replications. The application of a chemical control to the disease and non-application were the main plots and varieties and lines of mungbeans were the sub-plots. In each sub-plot, mungbean variety or line was planted in four rows which spaced 50 cm apart. The spacing between hills was 20 cm with 2 plants per hill. Seeds of susceptible varieties and lines were mixed and planted around the plot to provide sources of natural disease inoculum. Fertilizer formula NPK 12-24-12 was applied at the rate of 187 kg ha^{-1}.

The control of the disease was by application of benomyl [methyl 1- (butylcarbamoyl)-benzimidazol-2-ylcarbamate 50% WP] which was applied weekly until the first harvest for the disease control treatment. Weed control was made by the application of alachlor [2-chloro-2',-6'- diethyl-N-methoxymethyl) acetanilide 48% w/v EC] as a pre-emergence herbicide and hand weeding was done afterwards as needed. Supplemental sprinkler irrigation was used if there was no rain for more than 7 days. Insects were controlled by the application of carbosulfan (2-3-dihydro-2, 2 dimethyl- benzofuran-7-yl *N* (dibutylaminothio) *N*-methylcarbamate 20% w/v EC)

Characters measured were seed yield, yield components including seed weight per plant, seeds per plant, pods per plant and seed size. Individual plants were scored for powdery mildew response at 55 days after planting using the scoring system described by Young *et al*. (1993) as follows : 1; no visible mycelial growth, 2; 1 - 25% foliage area covered by fungus; 3;26 - 50% foliage covered, 4; 51 - 75% foliage covered, and 5; 76 - 100% foliage covered.

After harvest, seed samples of each variety and line taken from all four replications in the sub-plot were mixed and kept at room temperature. This seed was tested in three replications of 100 seeds each, for germination two and ten months after harvest according to the method described by ISTA (1999). The same stored seed was tested for seedling vigor using an accelerated aging test and used for preparation of bean sprouts two and ten months after storing using the procedure described by Tsou *et al*. (1985).

Results and Discussion

The application of fungicide to mungbeans in an attempt to control powdery mildew resulted in a difference in all characters indicating that chemical control was effective and that the disease affected these characters of mungbeans either directly or indirectly (Table 1). Mungbean varieties and lines were different in seed yield,

Table 1. Results from analysis of variance for effects of powdery mildew on different characters of mungbeans tested over two seasons

Source	df	Seed yield	Seed weight per plant	Seeds per plant	Pods per plant	Seed size	Disease score
Season (S)	1	**	**	**	**	**	*
Chemical (T)	1	**	**	**	**	*	**
S x T		*	ns	*	ns	ns	ns
Mungbean (M)	4	**	ns	**	**	**	**
S x M	4	**	**	**	**	**	*
T x M	4	**	**	**	**	*	**
S x T x M	4	ns	ns	ns	**	ns	*
CV (T) %		10.6	13.6	10.1	10.4	5.9	31.8
CV (M) %		11.1	9.6	9.5	7.5	5.1	22.2

*, **, ns = significant at 0.05, 0.01 levels of probability and not significant, respectively

yield components and scores for resistance to powdery mildew. SUT4 and VC3689A were highly and moderately resistant to the disease, respectively as they gave lower disease scores than others in both with and without applications of fungicide (Table 2). The infection of susceptible varieties and lines was quite severe without the disease control. This resulted in a statistical decrease in seed yield due to the disease. No yield loss was found due to the disease for SUT4, the resistant variety variety, but the losses were high for susceptible ones, especially Chainat 36. SUT4 is known for resistance to the disease, as it was used previously for breeding for resistance to powdery mildew (Chaitieng, 2002). The average yield loss due to the disease over the two seasons, excluding the resistant variety (SUT4), was 26.21%.

The disease adversely affected all yield components of mungbeans including seed weight per plant, number of seeds per plant, number of pods per plant and seed size (Table 3). The reduction of these characters was low or not observed for SUT4 and VC3689A but high for Chainat 36, Chainat 60 and VC3476A. Among these characters, the number of seeds per pod was most sensitive, whereas seed size was less sensitive to the disease. The reductions of these characters were undoubtedly contributable to the reduction of seed yield.

Table 2. Seed yield of mungbeans grown over two seasons affected by powdery mildew

Variety/ Line	Fungicide[1]		Mean yield	Difference[2]	Yield reduction	Disease score	
	with	without				Fungicide	Control
	.....(kg/ha).....				(%)		
SUT4	1,537b	1,533a	1,535	4	0.26	1.1	1.1
VC3689A	1,500b	1,386b	1,443	114**	7.60	1.3	1.6
Chainat 36	1,886a	1,180c	1,533	706**	37.45	1.9	4.2
Chainat 60	1,450c	1,032c	1,241	418**	28.83	1.5	3.9
VC3476A	1,579b	1,090c	1,335	489**	30.97	1.8	3.9
Mean	1,590	1,244	1,417		26.21[3]		

(1) Means followed by different letters are significantly different at 0.01 probability level according to DMRT

(2) ** = significantly different at 0.01 probability level according to lsd

(3) Mean of four susceptible varieties/lines

Table 3. Percent of reduction of various characters of mungbeans affected by powdery mildew[1]

Variety/ Line	Seed wt per plant	Seeds per pods	Pods per plant	Seed size	Germination		Seedling vigor		Bean sprout	
					2 MAH	10 MAH	2 MAH	10 MAH	2 MAH	10 MAH
	----------	----------	----------	----------	(%)	----------	----------	----------	----------	----------
SUT4	0	5.88	0	0	3.26	5.13	11.86	10.26	4.17	8.87
VC3689A	4.65	16.72	10.55	3.59	8.89	11.11	27.72	47.05	10.01	2.46
Chainat 36	31.79	36.00	21.14	6.85	24.08	32.26	14.89	70.60	12.81	37.92
Chainat 60	16.36	39.09	15.88	3.07	2.47	11.60	30.77	24.00	7.37	27.04
VC3476A	25.55	44.08	32.50	10.55	11.11	29.73	35.18	57.14	6.98	32.46
Mean[1]	19.58	33.22	20.02	6.02	11.64	21.18	27.15	49.69	9.29	32.47

(1) Means of four susceptible varieties/lines

(2) MAH = months after harvest

The disease was found to reduce rates of seed germination, seedling vigor and weight of bean sprout. The reduction of germination of susceptible varieties and lines ranged from 2.47 percent for Chainat 60 to 24.08 percent for Chainat 36. The adverse effect on the germination rate was higher for the seed stored for ten months. This indicates that, for mungbean seed production, effective means of disease control should be employed. A similar response was found for seedling vigor. The reduction of seedling vigor was high for susceptible varieties and lines. If the affected seed was stored for ten months, the reduction was as high as 70 percent for Chainat 36 compared with the treated seed. The reduction in weight of mungbean sprouts obtained from affected seed compared with treated seed of susceptible varieties and lines was in the range of 6.98 to 12.81 percent for the seed stored for two months. The reduction was very much higher for the seed stored for ten months.

This study showed that powdery mildew adversely affected many characters of mungbean. The reduction of seed yield might result from the effect of the disease on yield components. The disease was also found to reduce the rate of seed germination, seedling vigor and weight of bean sprouts.

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