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SEED GERMINATION, VEGETATIVE GROWTH AND YIELD OF *Vigna radiata* UNDER THE INFLUENCE OF FUNGICIDE THIOPHANATE METHYL

ASTIK KUMAR BUTS[a1], DIVYA SINGH[b] AND MANORMA SINGH[c]

[abc]PG Department of Botany, D.S. College, Aligarh, Uttar Pradesh, India

ABSTRACT

The experiment was conducted to evaluate the influence of thiophanate methyl on seed germination, vegetative growth and yield of *Vigna radiata* variety PM-5 during it's whole life cycle up to two generations under the natural conditions in the field. The seeds were treated with 0.25%, 0.50%, 0.75% & 1% concentration of thiophanate methyl before sowing in the experimental plots and the resulting plants were considered as M_1 generation. The seeds obtained from M_1 generation were again treated with the corresponding concentration of thiophanate methyl before sowing in the experimental plots. The results showed a decreasing trends in the germination percentage, seedling survival, plants height, number of branches per plant, number of pods per plant and average weight of 100 seeds with increasing the treatment concentrations in both M_1 & M_2 generation. However, 0.25% treatment concentration showed a little better impact in comparison to control on germination, vegetative growth and yield in both generation. Therefore, the recommend dose of thiophanate methyl for the treatment of seeds of *Vigna radiata* variety PM-5 is up to 0.25%. Above 0.25% treatment concentration adversely affect the plant's growth and yield.

KEYWORDS : *Vigna radiata*, Thiophanate methyl, Growth, Yield

Pulses are one of the important dietary component of Indian thali. Pulses help to improve protein intake of meals in which cereals & root tubers in combination with pulses are eaten. Legume plants have the special ability of secreting a chemical signal that "enlists" friendly bacteria to convert nitrogen into ammonia and other nitrogenous compounds. According to Sharma & Behera (2009) legumes contribute a lot towards N-economy in cereal-based cropping systems. Pulses are cholesterol free and are low in fat (except soybean and peanut).

Despite the difficulty of inferring domestication, archaeobotanical evidence attests to the widespread cultivation of pulses in Neolithic and Chalcolithic South Asia from at least the early to mid-3rd millennium BC (Dorian Q Fuller and Emma L. Harvey, 2006).

Vigna radiata is the botanical name of mung bean, also named as Phaseolus aureus roxb, placed in the order–fabales and family-fabaceae. Commonly it is known as mungbean, green gram, mungo, golden gram or mung.

Soil deterioration, depletion of water tables, salinization, increased pests, diseases and environmental pollution due to continuous cropping of cereals can be overcome by diversifying crop rotations with mung bean (Shanmugasundaram, 2006).

Mung bean plants are susceptible to many pathogens. So there is a need to control these pathogens and for this purpose many insecticides have been used by the farmers to prevent the crop. But many studies reveals that it's indiscriminate use can also cause many serious problems for human beings, environment, water bodies, plants itself and soil quality too.

Campelo et al. (2007) reported that fungicide application significantly improved root growth in *Phaseolus vulgaris*. When fungicide in combination with the Mo applications, applied once (at an early growth stage) or twice in the bean (*Phaseolus vulgaris*), the flowering period (25-45 Days after application) should provide substantial control of Angular leaf spot (Jesus Junior et al.,2004). Some benzimidazole fungicides can cause growth reductions and visual damage in bedding plants (Marc W. Van Lersel and Bruce Bugbee, 1996).

Fungicides may cause a greater difference between activities of the enzymes 7 ATP content especially when the rates used are higher than the recommended dose. The grain legumes grown in low-rainfall (<300mm per annum) cropping regions of southern Australia have failed to provide the rotational benefits observed in other regions because of the pesticides treatment (E.A. Drew et al., 2007).

The increasing concentrations of the fungicide decreased seed germination and growth parameters of black gram and it was more in 24 h treated seeds than in 6 h treated seeds (Neelamegam et al.,2007). Indiscriminate use of

[1]**Corresponding author**

agrochemicals on farms can affect soil flora and subsequently food production (Ampofo et al.,2009; A.K. Buts et al, 2013)

The purpose of the present study is to evaluate the impact of different concentrations of thiophanate methyl on seed germination, plant height, number of branches, time taken for initiation of flowering, number of pods per plants, period of harvesting & weight of 100 seeds of *Vigna radiata* in M_1 & M_2 generations. Several workers have also reported the effect of thiophanate methyl on different plants considering particular activities but we have considered it's overall impact on the germination, growth and yield in field condition.

MATERIALS AND METHODS

Seeds of *Vigna radiata* (2n = 22) were procured from GBPU Agriculture & Technology, Pantnagar. Healthy seeds of equal size & shape were selected for treatment with Thiophanate Methyl. Molecular weight of Thiophanate Methyl ($C_{12}H_{14}N_4O_4S_2$) is 342.4. Dry dormant seeds of the test material were first soaked in water for 6 hours and then treated with four designed concentrations of the chemical. The concentrations were 0.25%, 0.50%, 0.75% and 1.0%.The duration in each treatment was maintained uniformly which was six hours. All the treatments were given in freshly prepared aqueous solutions at room temperature with intermittent shaking. After treating and shaking for six hours, the seeds were taken out and thoroughly washed in water thrice for six minutes in which each treatment was given. Hundred seeds of each treatment were sown in well maintained experimental plots under protection, in lines keeping distance of 15 cm between the plants and 30 cm between the lines.

The emergence of hypocotyls and cotyledons above the surface of the soil was taken as an index of germination. Arrangements were made for regular weeding & irrigation. Neither any chemical nor fertilizers were used. The seeds were sown in the field before mid of the July and harvesting was done within a period of September to October. The morphological characters were studied with respect to plant height, weight of hundred seeds etc. This is considered as M_1 generation.

Table 1: Effects of Thiophanate Methyl on Seed Germination, Morphology and Yield of *Vigna radiata* Variety PM-5 in M_1 Generation

Treatment (Thiophanate methyl)	Seed Germination	Seedling Survival	Plant Height (in cm) + SD	Days taken for 1st flowering	No. of branches/ plant + SD	No. of pods/ plant + SD	Harvesting Period	Wt. of 100 seeds (in gm) + SD
Control	88%	86%	61±18.37	32-34	5.6±1.48	17.4±6.06	54-90	3.729 ±0.10
0.25%	90%	87%	59±6.66	30-32	4.2±1.095	17.6±6.16	53-90	3.941±0.129
0.50%	87%	86%	57.7±8.31	30-32	3.9±1.048	17.2±4.53	53-90	3.782±0.207
0.75%	86%	83%	57.5±7.59	30-32	3.8±1.09	16.1±03.6	53-90	3.442±0.076
1.00%	80%	79%	56.7±3.33	30-32	3.5±1.048	15.2±5.65	53-90	3.202±0.064

Mature seeds of M_1 generation from the plants treated with different concentration were harvested and stored separately to have four sets. These sets were used next year in the same way after giving the treatment of different concentration of Thiophanate Methyl and the resulted crops was considered as M_2 generation. The seeds of each set were treated with the corresponding concentration of Thiophanate Methyl. Morphological characters were recorded in M_1 & M_2 generations and finally the phenotypic variability and seed yield were calculated.

RESULTS AND DISCUSSION

The results obtained in the present study have been shown in table 1 & 2 and figures 1(A-E) and expressed together with the discussion in separate heading as under.

Effect on Germination of Plants

The germination percentage in M_1 generation were 90%, 87%, 86% and 80% in 0.25%, 0.50%, 0.75% and 1% concentration treatment respectively and in control it was 88% (table,1). At the same time, in M_2 generation, germination percentage with 97%, 97%, 93% and 90% were observed in 0.25%, 0.50%, 0.75% and 1% treatment concentration respectively while in control, it was 96% (table, 2).

Germination percentage is showing a decreasing trend in both the generation but in comparison to control an increase is there in 0.25% concentration treatment of M_1 generation and 0.25% and 0.50% concentration treatment of M_2 generation. However in M_2 generation it remains same in 0.25% and 0.50% treatment concentration. In comparison to control maximum decrease is there in 1% concentration treatment and is of 9.09% and 6.25% in M_1 and M_2 generation respectively (fig.1). This increase in germination percentage might be due to the decrease of seed mycoflora (kale et al., 1992).

Seedling Survival percentage

Survival of seedlings were 87%, 86%, 83%, and 79% in M_1 generation and 95%, 94%, 90%, and 88% in M_2 generation in 0.25%, 0.50%, 0.75 % and 1% concentration treatment respectively. The survival percentages among untreated plants are 86% and 95% in M_1 and M_2 generation respectively.

Table 2 : Effects of Thiophanate Methyl on Seed Germination, Morphology and Yield of *Vigna radiata* Variety PM-5 in M_2 generation

Treatment (Thiophanate methyl)	Seed Germination	Seedling Survival	Plant Height (in cm) + SD	Days taken for 1st flowering	No. of branches/ plant + SD	No. of pods/ plant + SD	Harvesting Period	Wt. of 100 seeds (in gm) +SD
Control	96%	95%	47.00±10.76	33-35	4.96±0.89	17.81±08.76	67-100	3.187±0.161
0.25%	97%	95%	47.50±19.41	32-34	4.44±1.16	17.54±10.51	67-100	3.433±0.129
0.50%	97%	94%	47.19±11.13	32-34	4.18±1.33	16.68±09.51	67-100	3.239±0.176
0.75%	93%	90%	46.82±11.54	32-34	3.32±1.36	15.84±10.66	67-100	3.118±0.222
1.00%	90%	88%	44.82±15.68	32-34	3.15±0.51	14.52±5.508	67-100	3.086±0.112

In comparison to control, maximum decrease was observed in 1% concentration treatment treated seeds in both generations however it started decreasing from 0.75% concentration treatment in M_1 generation and from 0.50% concentration treatment in M_2 generation. A decrease of 8.14% and 7.37% were observed in M_1 and M_2 generation respectively in 1% treatment concentration (fig. 1B).

Height of Plants

Data clearly indicates that average height of plants decreased with increase in the concentration treatment. In M_1 generation, average height of plants were 59cm, 57.7cm, 57.5cm and 56.7cm in 0.25%, 0.50%, 0.75% and 1% concentration treatment treated respectively in comparison to 61cm in control (table,1). In M_2 generation, average height of plants were 47.50cm, 47.19cm, 46.82 cm and 44.82 cm in 0.25%, 0.50%, 0.75% and 1% treatment concentration treated plants respectively in comparison to 47cm in control (table, 2).

Maximum decrease of 7.05% and 4.63% in the average height of the plants were observed in 1% concentration of thiophanate methyl treatment in M_1 and M_2 generation respectively (fig.1C).

Height of the treated plants in all treatment concentration was lower in comparison to control in M_1 generation. But in M_2 generation, there is an increase in height up to 0.50% treatment concentration. Similar observation was also reportsd by I.A.I. Mohammed et al. (2006). They also observed an increase in guar in comparison to control when treated with 4000ppm of thiophanate methyl.

Days Taken For First Flowering

There was no significant difference in days taken for initiation of flowering in comparison to control. It was almost same for plants treated with different treatment concentration in both M_1 and M_2 generation.

Number of Branches Per Plant

The average number of branches decreased with increase in the treatment concentration in both M_1 and M_2 generation. In M_1 generation, average number of branches were 4.2, 3.9, 3.8 and 3.5 in 0.25%, 0.50%, 0.75% and 1% treatment concentration treated plants respectively. In M_2 generation, average number of branches were 4.44, 4.18, 3.32 and 3.15 in 0.25%, 0.50%, 0.75% and 1% treatment concentration treated plants respectively. In control it was 5.6 and 4.96 in M_1 and M_2 generation respectively.

Here, in both the generations, average number of branches in control was higher than in treated plants. A decrease of 25%, 30.36%, 32.14% and 37.5% in M_1

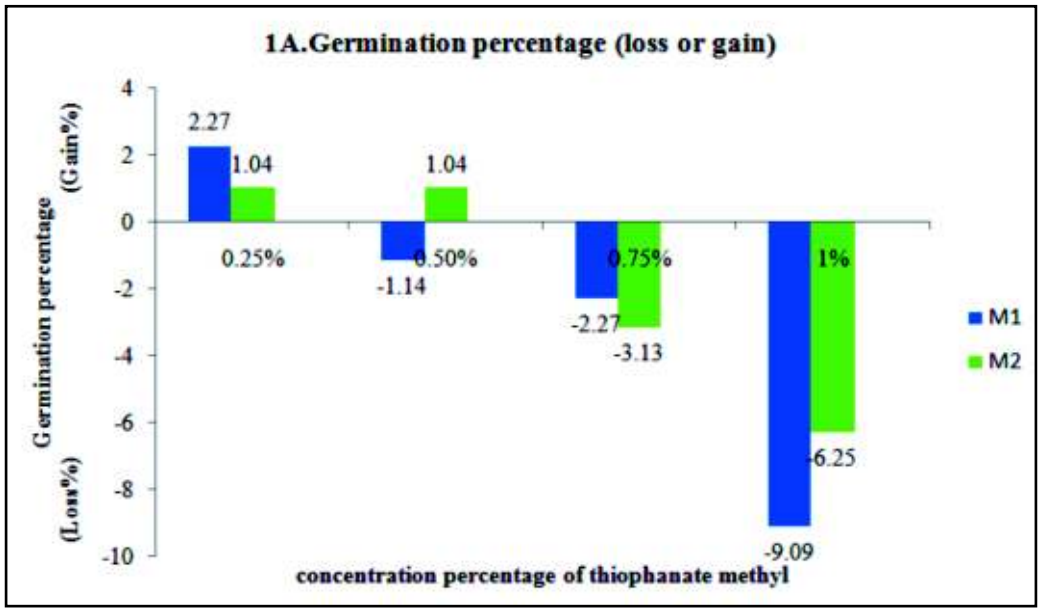

Figure 1A : Percentage loss or gain in respect to control in M_1 and M_2 generation in thiophanate methyl treated seeds of *Vigna radiata* variety PM-5

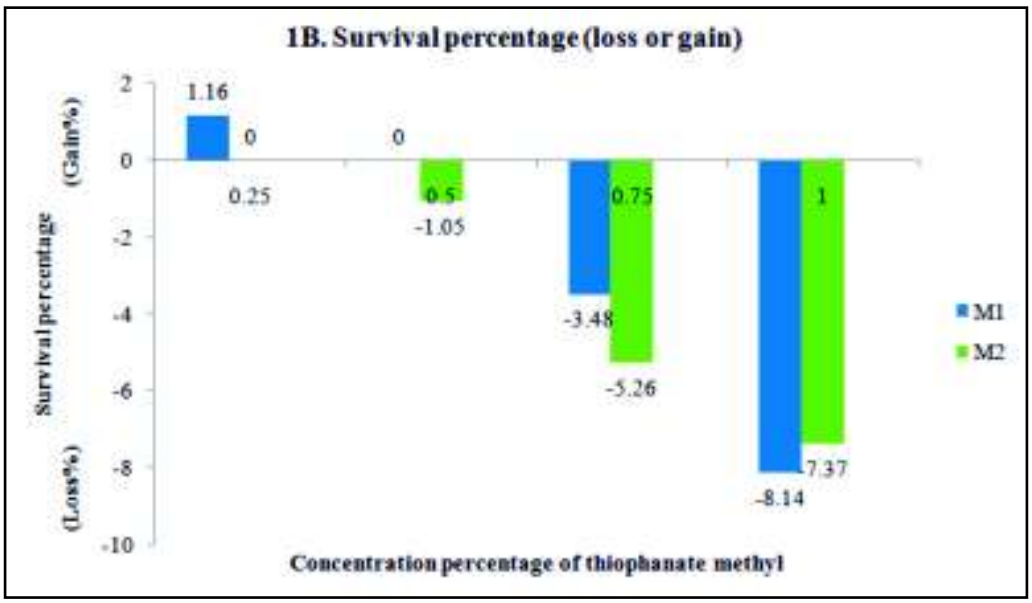

Figure 1b : Percentage Loss Or Gain in Respect to Control in M_1 and M_2 Generation in Thiophanate Methyl Treated Seeds of *Vigna Radiata* Variety Pm-5

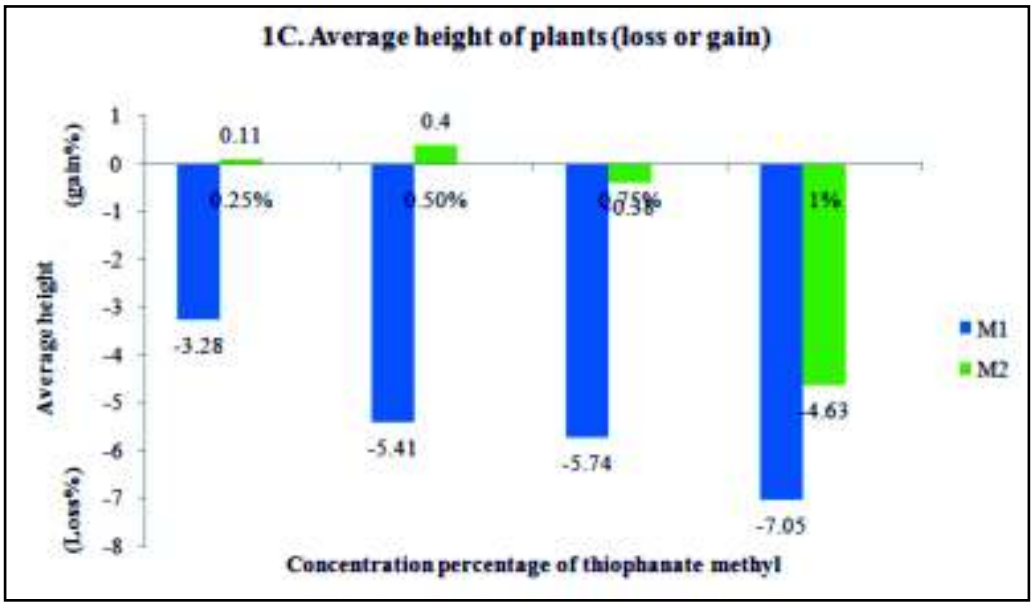

Figure 1C: Percentage Loss or Gain In Respect to Control in M_1 and M_2 Generation in Thiophanate Methyl Treated Plants of *Vigna radiata* Variety PM-5

generation and 10.48%, 15.73%, 33.06% and 36.49% in M2 generation were observed in 0.25%, 0.50%, 0.75% and 1% treatment concentration treated plants respectively (fig.1D). This variation clearly indicate that increase in the treatment concentration of thiophanate methyl reduced the number of branches but the losses incurred were inclined in M2 generation as compared to control.

Average Number of Pods Per Plant

The average number of pods per plant decreased with increase in the treatment concentration. In M_1

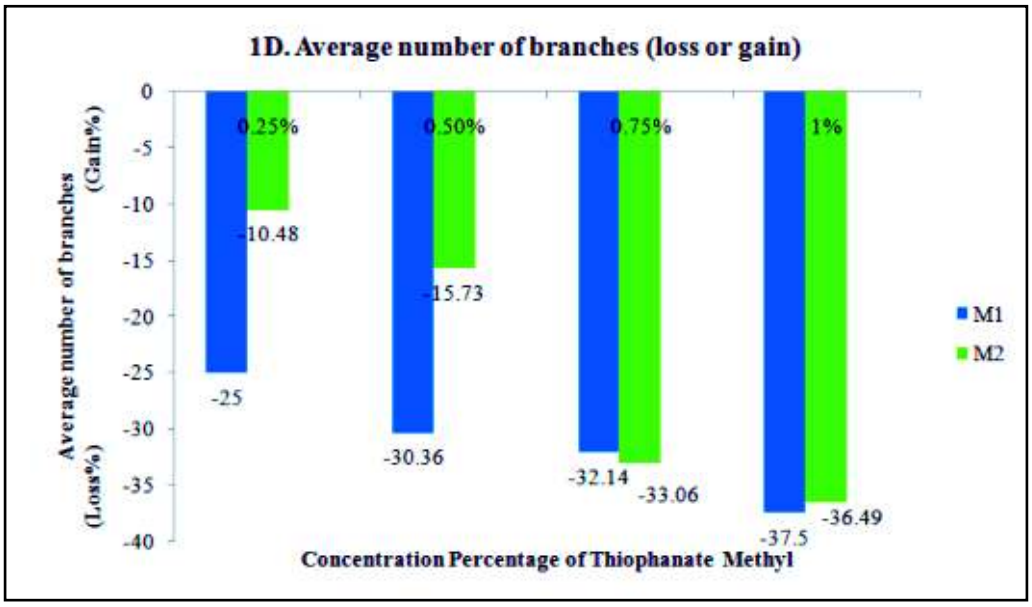

Figure 1D : Percentage Loss Or Gain in Respect to Control in M_1 and M_2 Generation in Thiophanate Methyl Treated Plants of *Vigna radiata* Variety PM-5

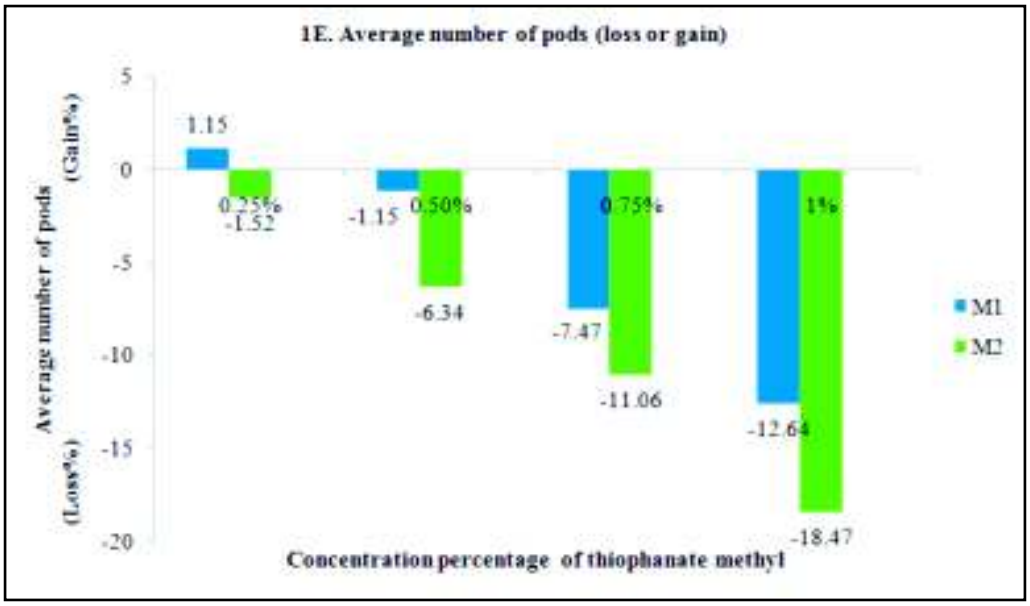

Figure 1E : Percentage Loss Or Gain In Respect to Control in M_1 and M_2 Generation in Thiophanate Methyl Treated Plants of *Vigna radiata* Variety PM-5

generation, average number of pods per plant were 17.6, 17.2, 16.1 and 15.2 in 0.25%, 0.50%, 0.75% and 1% treatment concentration respectively in comparison to 17.4 in control (table,1). In M_2 generation, the average number of pods per plant were 17.54, 16.68, 15.84 and 14.52 in 0.25%, 0.50%, 0.75% and 1% treatment concentration respectively in comparison to 17.81 in control (table, 2).

The average number of pods in control was higher than the treated plants with all the concentration in both generations except 0.25% treatment concentration treated

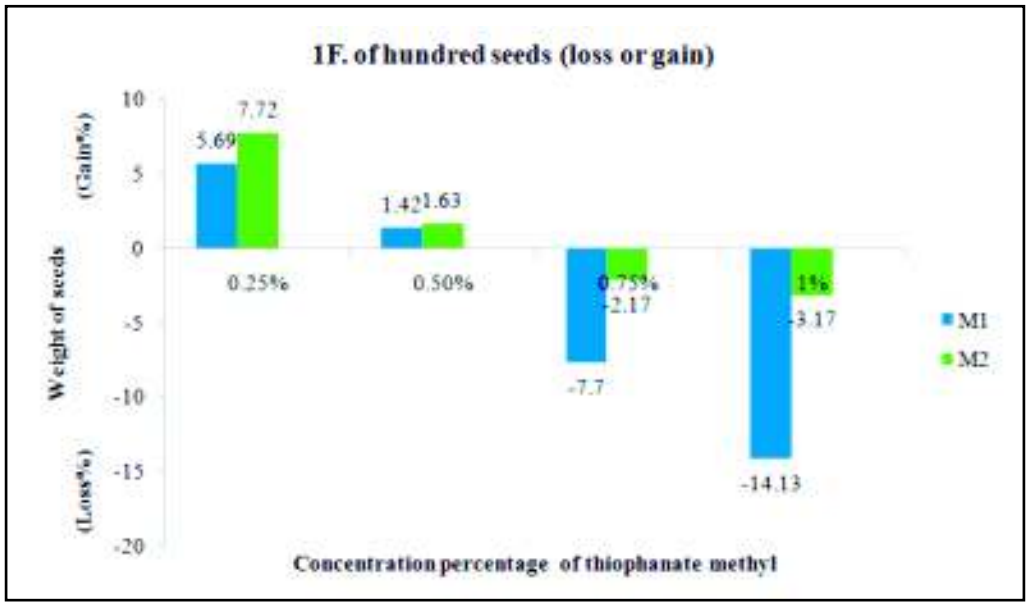

Figure1F : Percentage Loss Or Gain in Respect to Control in M_1 and M_2 generation in Thiophanate Methyl Treated Seeds of *Vigna radiata* Variety PM-5

plants of M1 generation (fig.1E). This finding also corroborate with the finding of I.A.I. Mohammed et.al. (2006), he also observed an increase @ of 4000ppm. Maximum decrease with 12.64% and 18.47% was observed in 1% treatment concentration in M_1 and M_2 generation respectively. Thus the average number of pods per plant decreased with the increased concentration of thiophanate methyl in both generations.

Harvesting Period

In M_1 generation, harvesting period ranges from 53-90 days since sowing of seeds in all the treated concentrations in comparison to 54-90 days in control. In M_2 generation, it ranges from 67-100 days for treated as well as untreated plants. Thus, there was no significant difference in harvesting period in both generations in comparison to control.

Weight of 100 Seeds

The average weight of 100 seeds were 3.941 gm, 3.782 gm, 3.442 gm and 3.202 gm in 0.25%, 0.50%, 0.75% and 1% treatment concentration respectively in M_1 generation while it was 3.729 gm in control (table,1). At the same time, in M2 generation, weight of 100 seeds were 3.433 gm, 3.239 gm, 3.118 gm and 3.086 gm in 0.25%, 0.50%, 0.75% and 1% treatment concentration respectively while in control it is 3.187 gm (table,2).

It is evident from the observed data that there was a continuous decrease in both M_1 and M_2 generation with increase in concentration of treatment. Maximum decrease of 14.13% and 3.17 % was observed in 1% treatment concentration in M_1 and M_2 generation respectively (fig.1F). However, weight of seeds in comparison to control was higher up to 0.50% treatment concentration in both generations. Thus, the weight of seeds in comparison to control is increased in lower concentration. This results also resemble with the results of Haverson et. al., 2010 and Astik Kumar Buts et al.,2013.

Thus, average weight of seeds also decreases with increasing treatment concentration. Decreasing trend in the average number of pods and weight of seeds clearly indicates the decrease in the crop yield with increasing treatment concentration of thiophanate methyl.

On the basis of the data recorded in the present investigation, it may be inferred that the treatment of the seeds of *Vigna radiata* with thiophanate methyl is safe up to 0.25%treatment concentration. Above 0.25% treatment concentration adversely affect the growth and yield of the

crop in both consecutive generations. It is apparent that a single dose treatment of seeds with thiophanate methyl affects the seed germination, morphology and yield of the crop. Therefore, the recommended dose of thiophanate methyl to control the seed borne fungus of *Vigna radiata* is up to 0.25%. Above 0.25% treatment dose adversely affect the growth and development of the crop and ultimately yield of the crop.

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