Asian Journal of Agriculture & Life Sciences Vol. 3(2), April 2018: 87-94

Website: www.crsdindia.com/ajals.html e-ISSN: 2455-6149

ORIGINAL ARTICLE

Assessment of the Toxicity of Mancozeb on Germination, Growth and Productivity of *Vigna radiata*

Astik Kumar Buts* and Divya Singh
P.G. Department of Botany, D.S. College, Aligarh, U.P., India
*Email: dr.astikbuts1968@gmail.com

Received: 7th Feb. 2018, Revised: 14th March 2018, Accepted: 21st March 2018

ABSTRACT

The present study was conducted to asses the toxicity of mancozeb on germination, growth and productivity of Vigna radiata selecting its' variety PM-5. The selected seeds were treated with 0.25%, 0.5%, 0.75% & 1% concentration of mancozeb before sowing in the experimental field and resulting plants were considered as M_1 generation. The seeds obtained from M_1 generation were further treated with corresponding concentration of mancozeb before sowing in the field to obtain M_2 generation. Observations showed no significant deleterious effect on germination and growth parameters like seedling survival and height of plants up to 0.5% treatment concentration of mancozeb. The deleterious effect showed increasing trends with increasing the treatment concentration above 0.5% on growth parameters. However no. of pods per plant continuously decreasing with increasing the treatment concentration in all the dozes of mancozeb taken for study. The weight of 100 seeds slightly increased up to 0.75% treatment concentration. But no. of pods per plant and weight of seeds together decides productivity. Hence, productivity showed decreasing trends with increasing the treatment concentration beginning from 0.25% of mancozeb which clearly reflect the toxic effect of mancozeb on Vigna radiata.

Key words: *Vigna radiata, PM-5, Mancozeb, Productivity*

INTRODUCTION

Mung bean is a short duration pulse crop. It is an important of human diet and fits well in different cropping system. Mung bean is an important grain legume in south Asia. Mung bean provides protein rich diet and also plays a significant role in sustaining crop productivity by adding nitrogen through rhizobial symbiosis and crop residues. Legumes adds substantial amount of nitrogen for sustainability of cereal crops. Mung bean is easily digestible free from flatulence. Mung bean adds much needed diversity to the cereal based diet of the poor (Thirumaran and Seralathan, 1988). Mung bean contains vitamin A (94mg), iron (7.3mg), calcium (124mg), zinc (3mg) and folate (549mg) per 100 gram dry seeds. Its' seeds contain 24.2% protein, 1.3% fat and 60.4% carbohydrates (Considine, 1982). Sprout which is a good source of Vitamin C (8mg/100gm) can be produced whole year at home or commercially (Gopalan *et al*, 1989).

Like other pulses, high yielding varieties of mung bean are also susceptible to mycoflora. Several fungicides and insecticides are used to control these mycofloral diseases and pests. Spraying of these chemical compounds also influence the plants. Insecticides (monocrotophos, endosulfan & phosphamidon) significantly reduced the AMF spore population, root colonization, plant dry weight and plant phosphorus content with higher dozes of spraying (Mou Wen Hua *et al*,2007). Through several studies, the side effect of the pesticides on the hereditary material of plant cells is put forward by different scientists (Soliman and Ghoneam, 2004; Jackson, 1969).

Its' inverse impact are also seen on nature, human beings etc. Application of excessive dozes of pesticides brings on utmost residue problem which affect human & animal health. According to Durmusoglu (2002), Pesticides used ignorantly pollute nature and could result a decrease in sensitivity of organism against these chemicals. It is found that crop injuries by agrochemicals in hybrid rice seed production were due to excessive and incorrect application of agrochemicals, unreasonable combination of agrochemicals and agrochemical residue in soil (Jayanthi, N. and Thalkappion, P., 2008).

Asogwa, E.U. and Dango, L.N. (2009) & Nas (2004) observed that the use of pesticides for effective pest control has generated a lot of concerns related to public health and environmental pollution.

Jagtap and Sontakke (2007) reported that chemical seed treatment with thiram (0.15%) + carbendazim (0.1%) proved to be the most effective against *F. oxysporium f.sp.ciceri.* Antle & Pingali (1994) observed that heavy pesticides use in food crops especially rice has triggered wide spread farmer health problems in Asia. Ganesh *et al* (2006), Mahesh and Hosmani (2004) & Buts *et al* (2013, 2016) have reported the adverse effect of bavistin on germination and many morphological characters in different crop plants. Ahemad, M. (2011), Aggarwal *et al* (2005) & Buts *et al* (2013, 2014) have reported the degree of toxicity of fungicides (tebuconazole, bavistin & dithane M-45) on the growth parameters in different crops. They observed that 01% fungicide concentration affect adversely all the crop plants taken for study. They also observed that type of plant organs affected may differ from one plant species to another.

Several workers have reported the effect of different fungicides on different plants taking few characters for study. But none have studied the effect of fungicides on the whole life cycle of the plant. The objective of this study is to assess the effect of mancozeb on germination, growth & productivity of *Vigna radiata* (mung bean) up to two generations.

MATERIAL & METHOD

The plant material taken for study is *Vigna radiata* (mung bean) variety PM-5 having chromosome number 2n=22 belongs to the family fabaceae. The seeds of variety PM-5 is obtained from GBPUAT (GB Pant University of Agriculture and Technology), Pantnagar.

Chemical fungicide Mancozeb is used for investigation to assess its' toxic effect in vivo on *Vigna radiata.* The treatment concentrations are 0.25%, 0.5%, 0.75% & 01%. Mancozeb is an organometallic compounds used as fungicides.

Healthy seeds with equal size & shape were selected for treatment with mancozeb. Dry dormant seeds were first soaked in water for four hours and thereafter hundred seeds were placed in separate petridishes containing concentration 0.25%, 0.50%, 0.75% & 01% of mancozeb for two hours in laboratory. Then treated seeds were sown in the well maintained experimental plots under protect in lines keeping a distance of 15 cm between the plants and 30 cm between the lines. 100 seeds soaked in water for six hours were sown experimental plot as control.

In the field, emergence of hypocotyle & cotyledons above the surface of the soil was taken as an index of germination. Arrangement was made for regular weeding & irrigation. Neither chemical nor any other chemical was used to avoid confusion. The seeds were sown in the field before mid of the July and harvesting was done within a period of September to October. In between that morphological and reproductive character were studied with respect to plant height, number of branches per plant, period of harvesting, number of pods per plant etc. Height of the plant was recorded at the time of maturity. After harvesting, weight of hundred seeds was recorded from control as well as from the treated plants. This was considered as M_1 generation.

Mature seeds of M_1 generation from the plants treated with different concentrations were harvested separately & stored separately. These seeds were used next year in the same way after giving treatment with corresponding concentration of mancozeb taken for study and resulted crop was considered as M_2 generation. The seeds of each set were treated with corresponding concentration of mancozeb. Morphological characters were recorded in M_1 & M_2 generations and finally the phenotypic variability and pod productivity were calculated. Raw data collected is compiled by standard statistical method. We calculated the mean of the observed data and find out the standard deviation to draw conclusion.

RESULT & DISCUSSION

Result obtained in present investigation have been sown in Table 1 & 2 and graph 1-6 and expressed together with discussion in separate headings as under-

EFFECT ON SEED GERMINATION:

The germination percentages were 90%, 86%, 83% & 78% in 0.25%, 0.50%, 0.75% & 01% treatment concentration of mancozeb in M_1 generation. In M_2 generation, it were 97%, 100%, 97% & 90% in 0.25%, 0.50%, 0.75% & 01% treatment concentration of mancozeb while it were 88% & 96% under control in M_1 and M_2 generation respectively.

Thus it is clear that in M_1 generation, there is a continuous decrease in germination percentage however in M_2 generation it increases up to 0.50% and then starts decreasing. In comparison to control, there is a decrease in all the concentrations except 0.25% in M_1 generation but in M_2 generation, an increase is observed in all the concentration except 01% (Fig.-1). 01% treatment concentration has showed negative impact in both generations.

Table 1: Effect of Mancozeb on quantitative characters of *Vigna radiata* variety PM-5 in M_1 generation

Treatment	Germination % in field	Seedling survival % in field	Height of plants (cm) ± S.D.	No. of branch per plant ± S.D.	Days taken for 1st flowering	Period of harvesting	No. of pods per plant ±S.D.	Weight of 100 seeds (gram) ±S.D.
Control	88	86	61.0 ± 18.37	5.6 ± 1.48	32-34	54-90	17.4 ± 6.06	3.729± 0.100
0.25%	90	86	59.6 ± 14.39	5.0 ± 1.60	30-32	53-90	14.0 ± 6.80	3.899± 0.116
0.50%	86	84	60.8 ± 12.90	5.0 ± 1.70	30-32	53-90	13.7 ± 7.30	3.935± 0.123
0.75%	83	80	56.6 ± 12.80	4.7 ± 2.30	30-32	53-90	13.1 ± 4.60	3.882± 0.082
1.00%	78	78	51.4 ± 05.40	3.9 ± 1.22	30-32	53-90	12.3 ± 3.30	3.635± 0.148

Table 2: Effect of Mancozeb on quantitative characters of *Vigna radiata* variety PM-5 in M_2 generation

Treatment	Germination % in field	Seedling survival % in field	Height of plants (cm) ±S.D.	No. of branch per plant ± S.D.	Days taken for 1st flowering	Period of harvesting	No. of pods per plant ±S.D.	Weight of 100 seeds (gram) ±S.D.
Control	96	95	47.34 ± 10.76	4.96± 0.89	33-35	67-100	17.81 ± 8.760	3.087± 0.161
0.25%	97	95	48.29 ± 15.63	3.44± 1.43	32-34	67-100	12.48 ± 8.597	3.139± 0.203
0.50%	100	96	48.95 ± 18.63	2.72± 1.09	32-34	67-100	12.13 ± 8.975	3.244± 0.148
0.75%	97	95	46.23 ± 17.04	2.13 ± 1.04	32-34	67-100	11.57 ± 7.983	3.138± 0.265
1.00%	90	87	42.23 ± 13.25	1.43± 0.74	32-34	67-100	11.03 ± 7.937	3.056± 0.161

EFFECT ON SEEDLING SURVIVAL:

Survival of plants in M_1 generation is 86%, 84%, 80% and 78% in 0.25%, 0.50%, 0.75% & 01% concentration treatment of mancozeb and in M_2 generation, it is 95%, 96%, 95% & 87% in respective treatment concentration while it is 86% & 95% in M_1 and M_2 generation under control. Deleterious effect is more in M_1 generation than M_2 generation which are 9.302% & 8.42% respectively in comparison to control (fig.-2).

EFFECT ON HEIGHT OF PLANTS:

In M_1 generation, average height of plants is found to be 59.6 cm, 60.8 cm, 56.6 cm and 51.4 cm in 0.25%, 0.50%, 0.75% and 01% concentration treatment of mancozeb respectively in comparison to 61.0 cm in control. In M_2 generation, the values for the same criteria are 48.29 cm, 48.95 cm, 46.23 cm and 42.23 cm respectively in comparison to 47.34 cm in control.

Thus observations showed that the average height in all the treated plants is lesser than the control in all the treatment concentrations in M_1 generation. This finding also corroborate with Aggarwal, A. *et al* (2005) findings. But in M_2 generation, an increase is observed up to 0.50% treatment concentration in comparison to control. Ehteshamul-Haque, S. and Abdul Ghaffar (1995) also reported in Soybean that height of plants showed an increase in 0.25% and 0.50% treatment with mancozeb in comparison to control. We found maximum decline in 01% treatment concentration (Fig.-3).

EFFECT ON NUMBER OF BRANCHES PER PLANT:

In M_1 generation, average number of branches are 5.0, 5.0, 4.7 and 3.9 in 0.25%, 0.50%, 0.75% and 01% treatment concentration of mancozeb respectively in comparison to 5.6 in control. In M_2 generation, branches are 3.44, 2.72, 2.13 and 1.43 in 0.25%, 0.50%, 0.75% and 01% concentration treatment respectively in comparison to 4.96 in control.

Data indicates that the average number of branches decreases with increasing the treatment concentration in both M_1 and M_2 generations. Highest number of branching is found in control in both generations. A decrease of 30.35% and 71.17% is observed in 01% treatment concentration in M_1 & M_2 generation respectively which reflect that mancozeb badly affect the branching process (Fig.-4).

EFFECT ON DAYS TAKEN FOR INITIATION OF 1ST FLOWERING:

There is no significant difference between the days taken for first flowering in different treatment concentration of mancozeb under taken for study. It is 30-32 days in comparison to 32-34 days in control in M_1 generation and 32-34 days in comparison to 33-35 days in control in M_2 generation.

EFFECT ON PERIOD OF HARVESTING:

The harvesting period is 53-90 days up to 01% treatment concentration of mancozeb in M_1 generation while it is 54-90 days under control. However in M_2 generation, the harvesting period is 67-100 days in both treated as well as untreated plants. Thus there is no significant variation is observed in duration of harvesting in comparison to control up to 01% concentration of mancozeb.

EFFECT ON NUMBER OF PODS PER PLANT:

The average number of pods per plant are 14, 13.7, 13.1 and 12.3 in 0.25%, 0.50%, 0.75% and 01% treatment concentration of mancozeb respectively in comparison to 17.4 under control in M_1 generation. In M_2 generation, the average numbers of pods are 12.48, 12.13, 11.57 and 11.03 in 0.25%, 0.50%, 0.75% and 01% treatment concentration respectively in comparison to 17.81 under control.

Thus the average number of pods under control are more in number than in treated plants in both M_1 and M_2 generation. There is a decrease of 29.31% and 38, 07% in comparison to control in number of pods in M_1 and M_2 generation respectively in 01% treatment concentration (Fig.-5). Hence, the observation clearly shows the decreasing trends with increasing treatment concentration of mancozeb regarding average number of pods. Therefore it drastically affect the productivity of the crop.

EFFECT ON WEIGHT OF SEEDS:

In M_1 generation, weight of 100 seeds are 3.899 gram, 3.935 gram, 3.882 gram and 3.635 gram in 0.25%, 0.50%, 0.75% & 01% treatment concentration of mancozeb respectively. In M_2 generation, weight of 100 seeds are 3.139 gram, 3.244 gram, 3.138 gram and 3.056 gram in 0.25%, 0.50%, 0.75% and 01% treatment concentration respectively. While in control, it is 3.729 gram and 3.087 gram in M_1 and M_2 generation respectively. Mancozeb showing better results in comparison to control in terms of weight of seeds up to 0.75% treatment concentration.

In M_1 and M_2 generation, average weight of hundred seeds is showing maximum increase in 0.50% treatment concentration of mancozeb in comparison to control. However an increase is there up to 0.75% concentration treatment. A decrease is observed in 01% concentration treatment in both

generations (Fig.-6). Shailbala Tripathi has also reported a positive impact in case of urdbean when treated with 0.25% concentration of mancozeb.

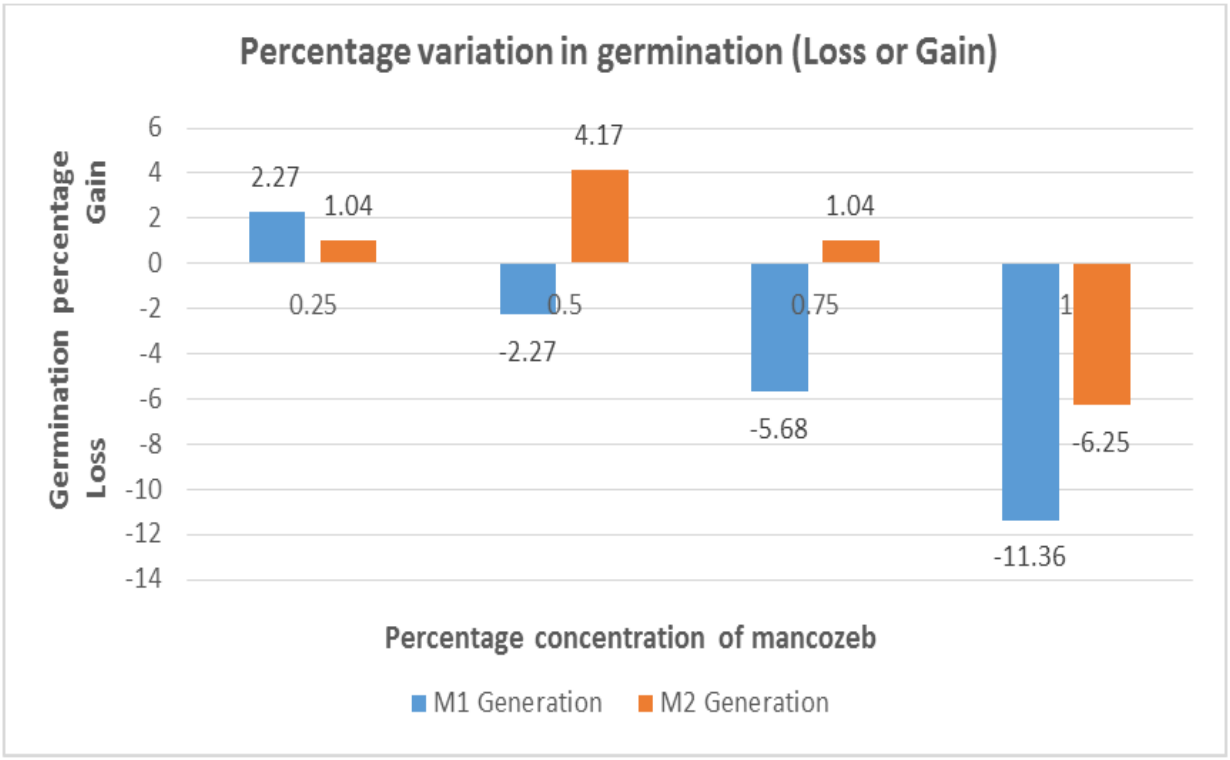

Fig. 1: Percentage loss or gain in respect to control in M_1 and M_2 generation in mancozeb treated seeds of *Vigna radiata* variety PM-5.

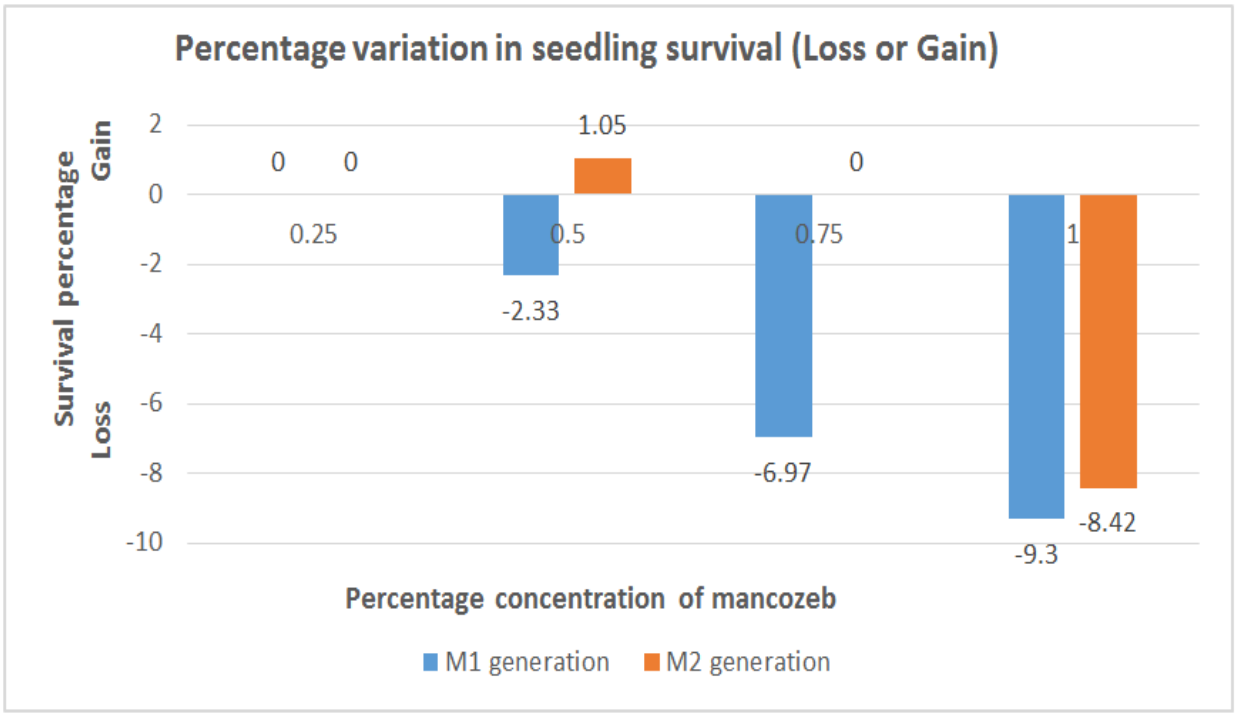

Fig. 2: Percentage loss or gain in respect to control in M_1 and M_2 generation in mancozeb treated seeds of *Vigna radiata* variety PM-5

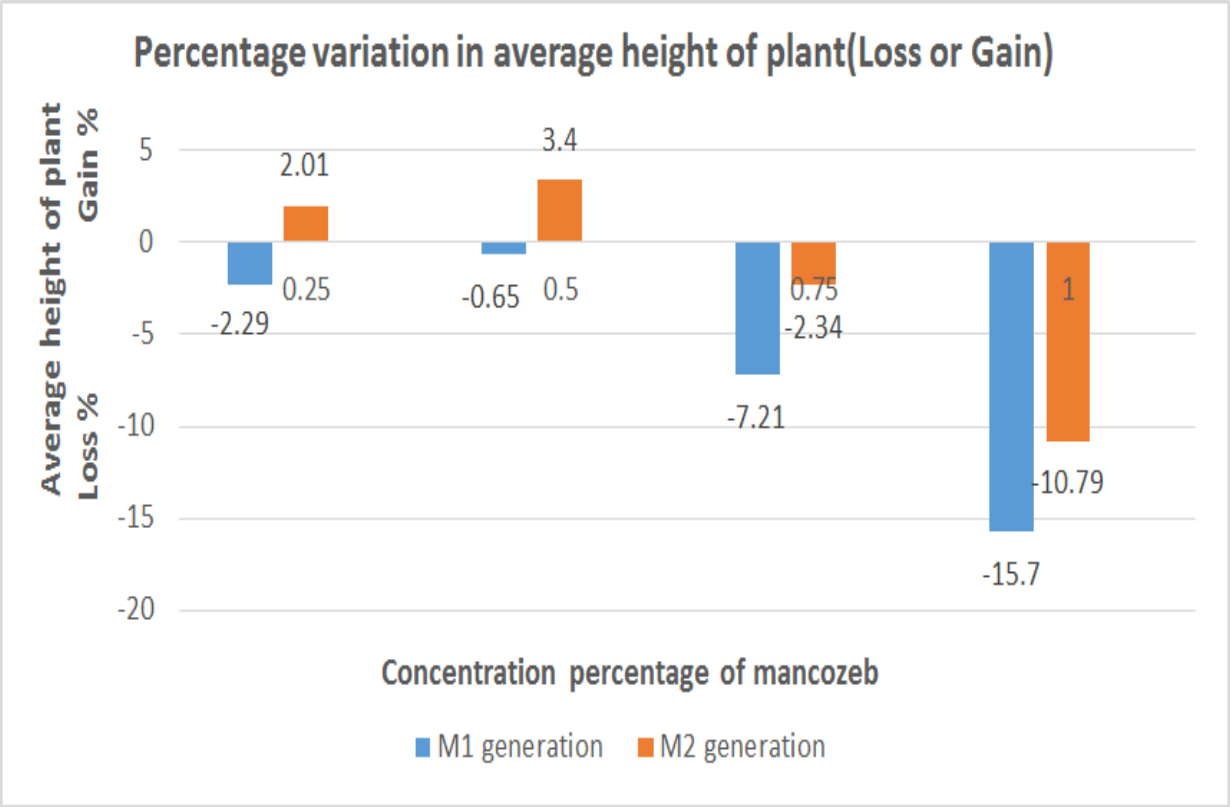

Fig. 3: Percentage loss or gain in respect to control in M_1 and M_2 generation in mancozeb treated plants of *Vigna radiata* variety PM-5.

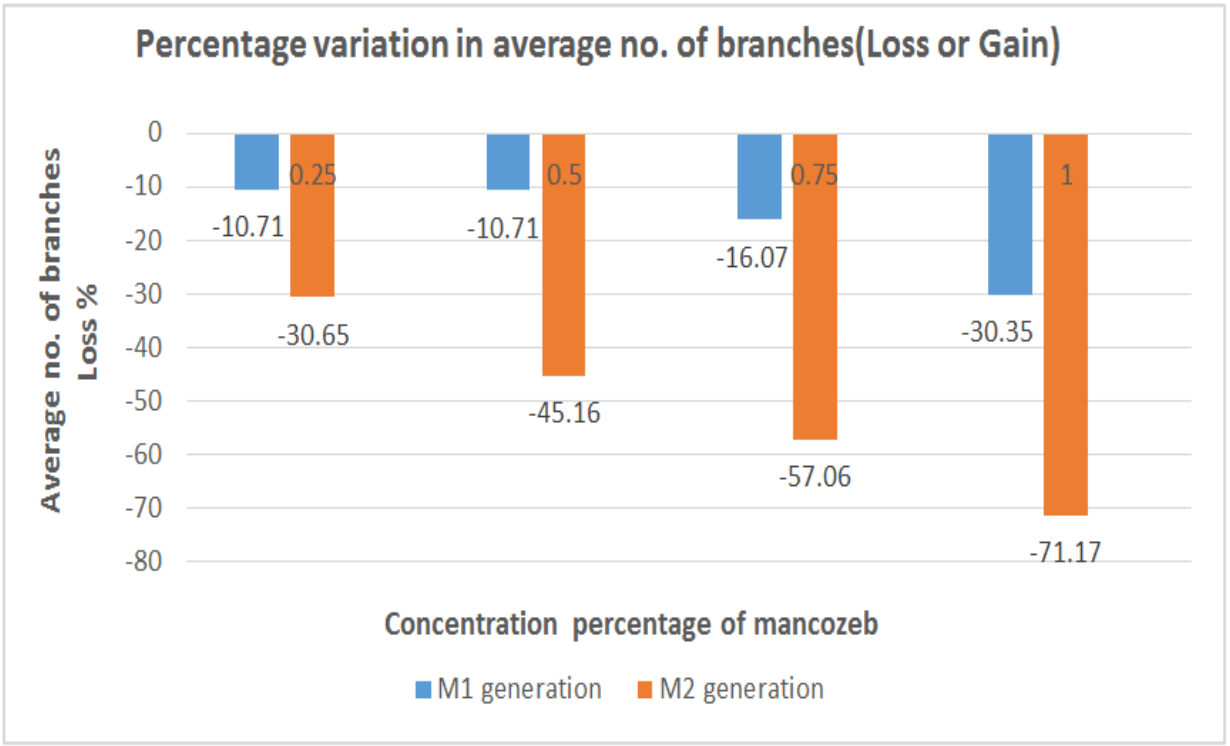

Fig. 4: Percentage loss or gain in respect to control in M_1 and M_2 generation in mancozeb treated plants of *Vigna radiata* variety PM-5

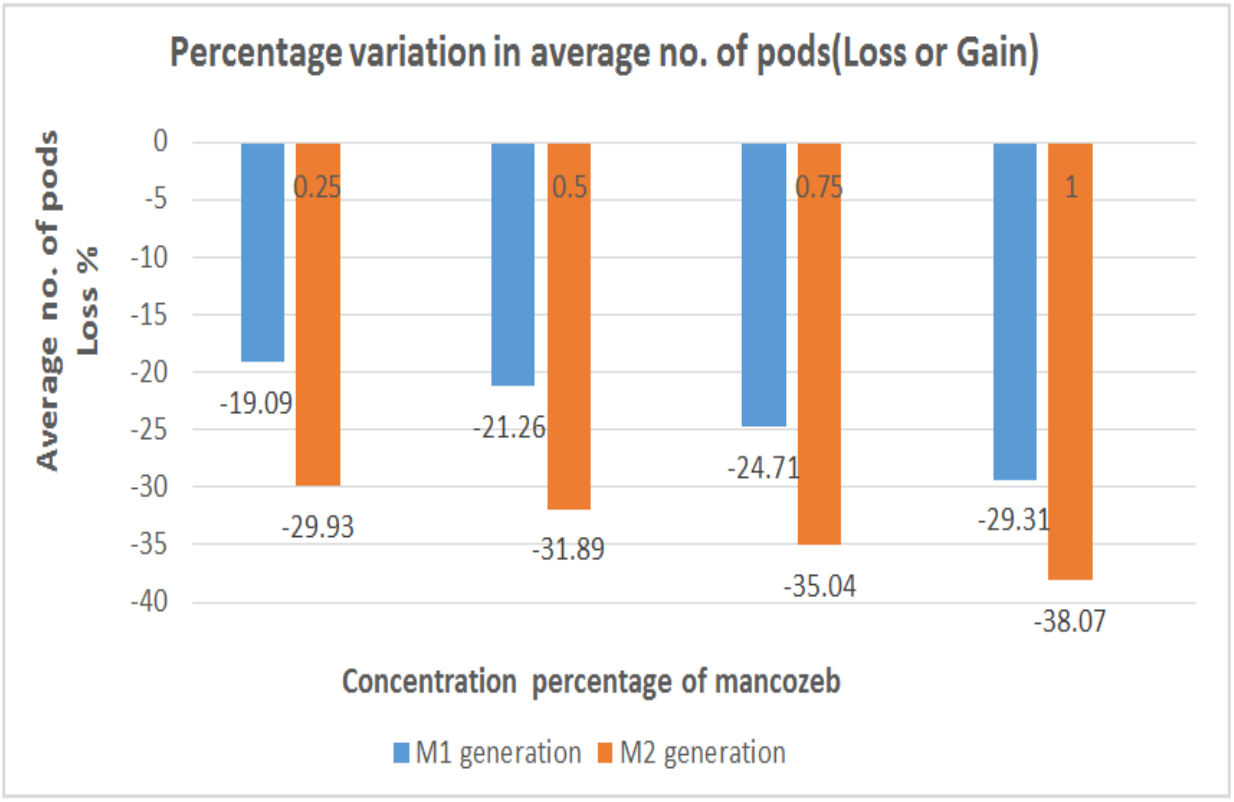

Fig. 5: Percentage loss or gain in respect to control M_1 and M_2 generation in mancozeb treated plants of *Vigna radiata* variety PM-5

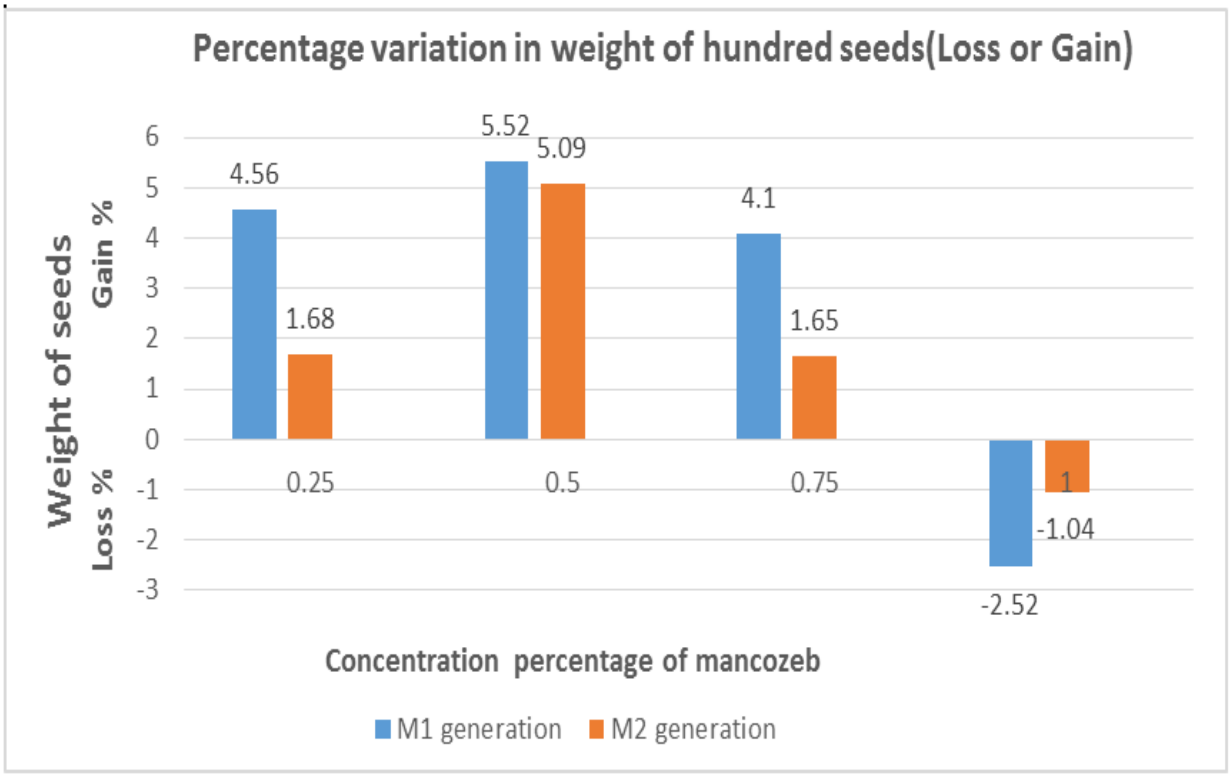

Fig. 6: Percentage loss or gain in respect to control in $M_1$and M_2 generation in mancozeb treated seeds of *Vigna radiata* variety PM-5.

We have tried to assess the toxic effect of mancozeb giving single doze treatment to seeds before sowing in the field on germination, growth parameters and productivity of *Vigna radiata* (mung bean) up to two generations. On the basis of observations and above discussion we can conclude that mung bean can tolerate the toxic effect of mancozeb up to 0.50% concentration in respect to seed germination, survival of plants and height of plants. Up to 0.50% concentration of mancozeb influence the germination, height of plant and weight of seeds. However it must be noted that even 0.25% concentration of mancozeb has badly affect the no. of branching and no. of pods per plants in both generations. Productivity depends upon the no. of pods per plants and weight of seeds. Observations clearly showed the decline in the productivity even in 0.25% concentration of mancozeb. The toxic effect on crop productivity increases with increase in the concentration.Thus farmer can utilize only up to 0.25% concentration to control the fungicides. Above this doze, the productivity is badly affected. Thus the awareness should be raised regarding reckless use of this (mancozeb) fungicide reflecting its toxic effect which may also affect the human health through bio-magnification.

REFERANCES

1. Aggarwal A., Sharma D., Prakash V., Sharma S. and Gupta A. (2005): Effect of Bavistin and Dithane M-45 on the mycorrhizae and rhizosphere microbes of sunflower. Helia, 28(42): 75-88.
2. Ahemad M. (2011): A comparative analysis of Tebuconazole mediated phytotoxicity to legumes. Journal of environmental science and technology, 4(6): 630-637.
3. Antle J.M. and Pingali P.L. (1994): Pesticides, productivity and Farmer health: A Philippine case study. American Journal of Agricultural Economics, 76: 418-429.
4. Asogwa E.U. and Dongo L.N. (2009): Problem associated with pesticides usage and application in Nigerian cocoa production: A review. African Journal of Agricultural Research, 4(8): 675-683.
5. Buts A.K., Singh D., Chaudhary V.L. and Singh M. (2013): Effect of Bavistin on seed germination, morphological features and yield of *Vigna radiata*. Indian journal of Life Sciences, 3(1): 15-20.
6. Buts A.K., Singh M. and Singh D. (2014): Effect of Dithane M-45 on growth and development of *Abelmoschus esculentus* (Okra). Indian Journal of Life Sciences, 3(2): 39-46.
7. Buts A.K., Singh M. and Singh, D. (2016): Effect of Bavistin on germination, growth and yield of *Abelmoschus esculentus* (Okra). Nature & Environment, 21(1): 60-68.
8. Considine M. (1982): Food and Food production Encyclopedia. Van Nostard Reinhold Book Co. New York, P.-173.
9. Durmusoglu E. (2002): Izmer'de pazara sunulan domates ve hiyarlarda bazi organic fosforlu insektisit kalintilarinin saptanmasi iizerinde arastirmalar. Turk. Entomol. Derg, 26(2): 93-104.
10. Ehtesamul-Haque S. and Ghaffar A. (1995): Effect of Bradyrhizobium japonicum and fungcides in the control of root ro disease of Soybean. Pak. J. Bot, 27(1): 227-232.
11. Ganesh K.S., Sunderamoorthy P., Sumathi K., Rajasekaran S. and Chidambaram A.A. (2006): Toxicological effect of bavistin on seed germination and growth behaviour of paddy seedling. Plant Archives, 6(2): 577-579.
12. Gopalan C., Ramasastri B.V., Balasubramnaian C.V., Narasingarao B.S., Deosthale Y.G. and Pant K.C. (1989): Nutritive value of Indian foods. Indian Council of Medical Research, Hydrabad, India. P. 156.
13. Jackson W.T. (1969): Regulation of mitosis II. Interaction of isopropyl phenylcarbamate and melatonin. J. Cell Sci., 5: 745-755.
14. Jagtap G.P. and Sontakke P.L. (2007): Management of chickpea wilt caused by *Fusarium oxysporium* f. sp. ciceri. Afr. J. of Agric. Res., 2(12): 692-697.
15. Jayanthi N. and Tholkappion P. (2008): Compatibility and toxicity of agrochemicals on the growth of MCU-7 cotton inoculated with *Glomus fasciculatum*. Plant Archives, 8(1): 57-60.
16. Mahesh M.K. and Hosmani S.P. (2004): Morphological changes and nutrient uptake in some cultivars of rice treated with bavistin. Journal of Ecotoxicology & Environmental Monitoring, 14(3): 195-198.
17. Mou Wen Hua, Zhu Yang Lin, Tang Shun Ying and Wang Ya Song (2007): Crop injuries caused by agrochemicals in hybrid rice seed production and preventive measures. Hybrid Rice, 22(5): 45-46.
18. Nas M.N. (2004): In vitro studies on some natural beverages *Curobacterium falaccumfaciens* sub-sp. Poinsettiae. Turk J. Agri., 28: 57-61.
19. Shailbala Tripathi H.S. (2004): Fungicidal management of web blight of urdbean. Indian Phytopathology, 57(1): 99-100.
20. Soliman M.I. and Ghoneam G.T. (2004): The mutagenic potentialities of some herbicides using *Vicia faba* as a biological system. Biotechnology, 3(2): 140-154.
21. Thirumaran A.S. and Seralathan M.A. (1988): Utilization of mungbean. In: Shanmugasundaram, S. and Mc. Lean, B.T. (eds.). Proceeding of the Second International Symposium on Mungbean. AVRDC, Shanhua, Taiwan. AVRDC Publication No. 88-305, p.470-485.