Print ISSN: 0976-2876 Online ISSN: 2250-0138

Available online at: http://www.ijsr.in

INDIAN JOURNAL OF SCIENTIFIC RESEARCH

DOI:10.32606/IJSR.V16.I1.00002

Received: 16-04-2025 Accepted: 25-07-2025 Publication: 31-08-2025

Indian J.Sci.Res. 16 (1): 07-13, 2025 Original Research Article

TOXICOLOGICAL IMPACT OF MANCOZEB ON REPRODUCTION, GROWTH AND YIELD OF *Pisum sativum* L.

SUNIL KUMAR[a] AND ASTIK KUMAR BUTS[b1]

[ab]Department of Botany, D.S. College, Aligarh, U.P., India

ABSTRACT

Toxicological effect of mancozeb was assessed taking two varieties i.e. IPF-99-25 (Adarsh) and IPFD-1-10 (Prakash) of *Pisum sativum* upto two generations. The seeds of both varieties were treated with 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration of mancozeb before sowing in the experimental field. This generation is designated as M_1 generation. The seeds obtained from M_1 generation was again treated with corresponding concentrations of mancozeb before sowing in the experimental field. This generation is designated as M_2 generation. No significant toxicological effect was observed on growth, reproduction and yield in both varieties upto 0.2% treatment concentration. However inducive effect was observed upto 0.3% treatment concentration treated plants in respect to average number of branches per plant. Seedling survival is also little better upto 0.2% treatment concentration. Above 0.2% treatment concentration of mancozeb negative impact begins. Above 0.3% treatment concentration, noticeable toxicological effect was observed on growth, reproduction & yield. The toxicological effect showed increasing trends with increase in the treatment concentration of mancozeb above 0.3% treatment concentration.

KEYWORDS: *Pisum sativum*, Mancozeb, Growth, Yield

Pisum sativum is an essential component of human diet due to it's protein, starch and other nutrients content. Presence of protein, starch, fibre, vitamins, minerals and phytochemicals in *Pisum sativum* is responsible for positive health benefits (Dahl *et al*, 2012).

Crops along with pea are influenced by many fungi, bacteria and viruses. Pesticides are used to prevent the crop from these hazardous organism. About 95 biochemical processes in pests like insect, weeds and dangerous fungi are targeted by the 700 different pesticides including insecticides, herbicides and fungicides (Casida, 2009).

Many phytopathogenic fungi attack plants. Specialized pesticides known as fungicides are used to prevent and control fungal diseases in home, gardening and agriculture. These include protecting plants during germination, safeguarding seed grain during transport and protecting mature crops. The effectiveness in managing all fungal related diseases remains limited (Aggrawal *et al*, 2005).

Pesticides, particularly fungicides like mancozeb (75% WP) are widely used to combat crop-damaging pests and fungi despite concerns about toxicity. Its effect on the early growth of the mustard (*Brassica juncea*) varieties RH-30 and Laxmi was investigated in an in vitro study. Three mancozeb doses i.e. 1 mg/kg, 2 mg/kg and 4 mg/kg, mancozeb reduced germination by 30-60% in RH-30 and 17-55% in Laxmi. Laxmi showed better growth and seed vigour after seven days, while RH-30 exhibited stunted development (Monika *et al*., 2017).

Carbendazim @ 2g a.i/kg seed significantly decrease the amount of chlorophyll, nodulation (60a) and nitrogen in shoot (Amil *et al*, 2004). Astik Kumar Buts *et al* (2013, 2016) also reported the adverse effect of bavistin on yield and morphology of *Vigna radiata* & *Abelmoschus esculentus*.

Jadon *et al* (2015) reported that tebuconazol 2 DS @ 1.5g kg^{-1} seed, mancozeb 75% WP @ 3g kg^{-1} seed, carbendazim 12% + mancozeb 63% WP @ 3g kg^{-1} seed were very effective in the management of soil borne disease when used separately with apparent yield advantage over untreated plants.

Firdos Fatima *et al* (2017) reported that higher concentration (150 ppm) of mancozeb inhibited the seedling growth, survival, root shoot ratio, tolerance, vigour index in *Vigna radiata* & *V. mungo.*

Khan *et al* (2009) reported that the mancozeb is very effective in fungal disease management of pea rust under field condition. Pradeep kumar *et al* (2012) also reported that carbendazim, mancozeb, & vitavex alone and in combination is very effect in controlling pea root/wilt complexes.

Thus different type of fungicides along with mancozeb are used to control fungal diseases in different type of crops. Now a days reckless use of these

[1]Corresponding author

fungicides are in practice. These fungicides not only control fungal disease rather it may also affect the crop itself. This experiment was done to assess toxicological effect of mancozeb taking its' different concentrations on *Pisum sativum* (Pea) taking its two varieties IPF-99-25 & IPFD-1-10.

MATERIALS AND METHODS

The study focused on two varieties i.e. IPF-99-25 (Adarsh) and IPFD-1-10 (Prakash) of *Pisum sativum*. The seeds of these varieties were obtained from the ICAR-Indian Institute of Pulses Research, Kanpur. We applied 0.1%, 0.2%, 0.3%, 0.4% and 0.5% concentration of mancozeb on both varieties of *Pisum sativum* to assess the toxicological effects of this organometallic fungicides.

Healthy seeds of uniform size and shape were selected for mancozeb treatment. The dry, dormant seeds were soaked in water for six hours. Then these soaked seeds were placed in separate petri-dishes with mancozeb concentrations of 0.1%, 0.2%, 0.3%, 0.4% and 0.5% for three hours. After treatment, the seeds were sown in well-maintained experimental plots with a distance of 10 cm between plants and 30 cm between rows. A control group of 100 seeds, soaked in water for six hours, were also sown in the experimental plot.

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 fertilizer nor any other chemical were used to avoid confusion. The seeds were sown in the field before mid of the November and harvesting was done within a period of March to April. In between that morphological and reproductive characters 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 seed was recorded from control as well as from the treated plants. This was considered as M_1 generation. Mature seeds of M_1 generation of plants treated with different concentrations of mancozeb were harvested separately. These seeds of both varieties 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. Seeds of both varieties of each set were treated with corresponding concentration of mancozeb. Morphological characters were recorded in M_1 & M_2 generations and finally the phenotypic viability and pod productivity were calculated. Raw data collected is compiled by standard statistical method. We calculate the means of the observed data and find out the standard deviation to draw conclusion.

RESULTS AND DISCUSSION

Result obtained in present investigation have been shown in table 1 to 4 and graph 1-6 and express together with discussion in separate heading as :-

Effect On Seed Germination

In variety IPF-99-25, germination percentage were 93%, 94%, 93%, 91%, & 86% in M_1 generation and 94%, 94%, 92%, 89%, & 86% in M_2 generation in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration of mancozeb respectively. In control, germination percentage were 94% & 92% in M_1 & M_2 germination respectively.

In variety IPFD-1-10, the germination percentage were 93%, 93%, 92%, 89%, 85% in M_1 generation and 93%, 92%, 91%,89%, & 86% in M_2 generation in 0.1%, 0.2%, 0.3%, 0.4%, and 0.5% treatment concentration of mancozeb respectively. In control, the germination percentage were 94% & 92% in M_1 & M_2 generation respectively.

Above data clearly showed decrease in germination percentage at above 0.3% treatment concentration of mancozeb in both varieties in both generations. Decrease in germination percentage increases with increase in the treatment concentration. However data also reflect a short of development of tolerance in M_2 generation in both varieties in respect to control. (Fig. 1).

Table 1: Effect of Mancozeb on quantitative characters of *Pisum sativum* variety IPF-99-25 in M_1 generation

Treatments (Mancozeb)	Germination of Seeds in the field	Seedling Survival	Height (cm) ± SD	Number of Branches per plant ± SD	Days taken for 1st flowering	Period of harvesting (in days)	No. of Pods/ Plant ± SD	Weight of 100 seeds (gram) ± SD
0.1%	93%	92 %	204.50±0.71	6.18±3.25	70-80	130-138	15.66±0.48	19.16±0.08
0.2%	94 %	92 %	197.5 ± 34.63	7.80±3.12	72-80	130-138	15.96±12.67	18.48±0.16
0.3%	93 %	91 %	193.70±18.49	8.35±0.27	73-81	130-138	15.39±6.81	17.95±0.06
0.4%	91 %	89 %	186.22±37.82	5.86±3.02	74-82	130-138	14.95±18.15	17.64±0.10
0.5%	86 %	81 %	180.44±46.21	5.27±3.69	74-82	130-138	14.39±13.50	17.53±0.13
Control	94 %	92 %	206.39±48.60	6.30±2.70	71-80	129-136	15.69±9.93	18.99±0.16

Table 2: Effect of Mancozeb on quantitative characters of *Pisum sativum* variety IPF-99-25 in M_2 generation

Treatments (Mancozeb)	Germination of Seeds in the field	Seedling Survival	Height (cm) ± SD	Number of Branches per plant ± SD	Days taken for 1st flowering	Period of harvesting (in days)	No. of Pods/ Plant ± SD	Weight of 100 seeds (gram)± SD
0.1%	94%	93 %	203.79±49.73	6.36±1.82	78-86	140-146	15.40±1.42	17.62±0.14
0.2%	94%	93 %	195.51±46.77	6.44±1.31	78-86	140-146	15.5±2.92	17.51±0.12
0.3%	92%	92 %	190.61±37.43	6.76±0.86	80-88	140-146	14.95±1.18	17.35±0.02
0.4%	89%	87 %	181.63±48.87	5.96±1.15	78-86	140-146	14.40±1.42	16.80±0.03
0.5%	86%	82 %	163.27±52.07	5.03±1.37	79-86	140-146	13.98±1.70	16.06±0.09
Control	92%	90 %	207.70±30.10	6.16±1.10	78-86	142-147	15.18±3.01	17.87±0.12

Table 3: Effect of Mancozeb on quantitative characters of *Pisum sativum* variety IPFD-1-10 in M_1 generation

Treatments (Mancozeb)	Germination Of Seeds in the field	Seedling Survival	Height (cm) ± SD	Number of Branches per plant ± SD	Days taken for 1st flowering	Period of harvesting (in days)	No. of Pods/ Plant ± SD	Weight of 100 seeds (gram)± SD
0.1%	93	92 %	102.42±24.83	3.18±1.78	72-80	127-133	9.21±8.43	17.85±0.25
0.2%	93	92 %	106.5±19.23	3.47±1.84	72-80	127-133	9.35±8.49	17.20±0.20
0.3%	92	90 %	98.17±19.15	3.6± 1.27	71-79	127-133	8.75±8.19	17.16±0.37
0.4%	89	87 %	91.09±14.93	3.04±1.22	70-78	128-134	8.35±7.60	17.14±0.58
0.5%	85	81 %	80.42±16.00	2.67±1.35	70-79	128-134	8.21±5.37	17.10±0.66
Control	94	91 %	108.55±24.19	3.09±0.83	71-79	131-136	9.28±3.30	18.70±0.02

Table 4: Effect of Mancozeb on quantitative characters of *Pisum sativum* variety IPFD-1-10 in M_2 generation

Treatments (Mancozeb)	Germination Of Seeds in the field	Seedling Survival	Height (cm) ± SD	Number of Branches per plant ± SD	Days taken for 1st flowering	Period of harvesting (in days)	No. of Pods/ Plant ± SD	Weight of 100 seeds (gram)± SD
0.1%	93	91 %	102.07±21.70	3.71±1.40	75-84	134-139	8.26±4.93	18.29±0.19
0.2%	92	91 %	96.20±20.29	4.04±1.33	74-83	134-139	8.73±5.31	18.03±0.26
0.3%	91	90 %	91.73±16.63	4.06±1.37	73-82	134-139	7.90±5.17	17.81±0.12
0.4%	89	86 %	86.87±20.27	3.06±1.33	73-82	134-139	6.68±5.66	17.58±0.14
0.5%	86	81 %	77.86±17.36	2.76±1.29	73-83	134-139	4.65±2.65	17.42±0.23
Control	92	90 %	107.06±11.42	3.16±0.53	75-84	138-142	8.7±3.52	18.28±0.11

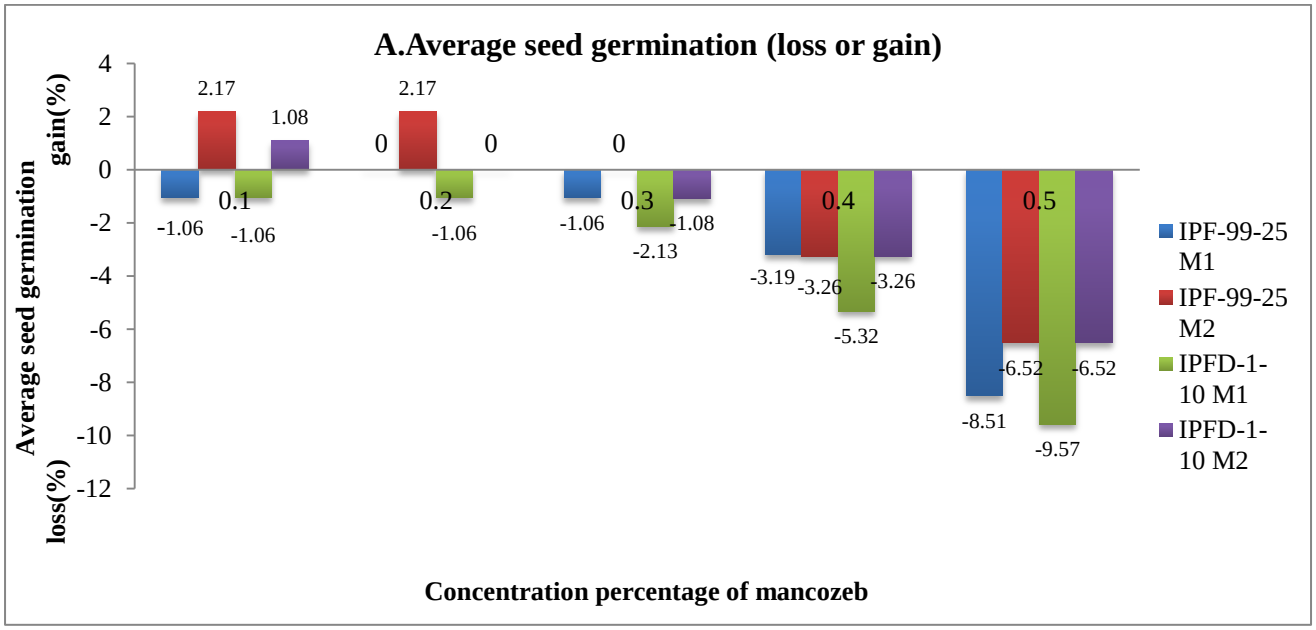

Figure 1: Percentage variation in average seed germination of *Pisum sativum* treated with Mancozeb in respect to control in M_1 & M_2 generation

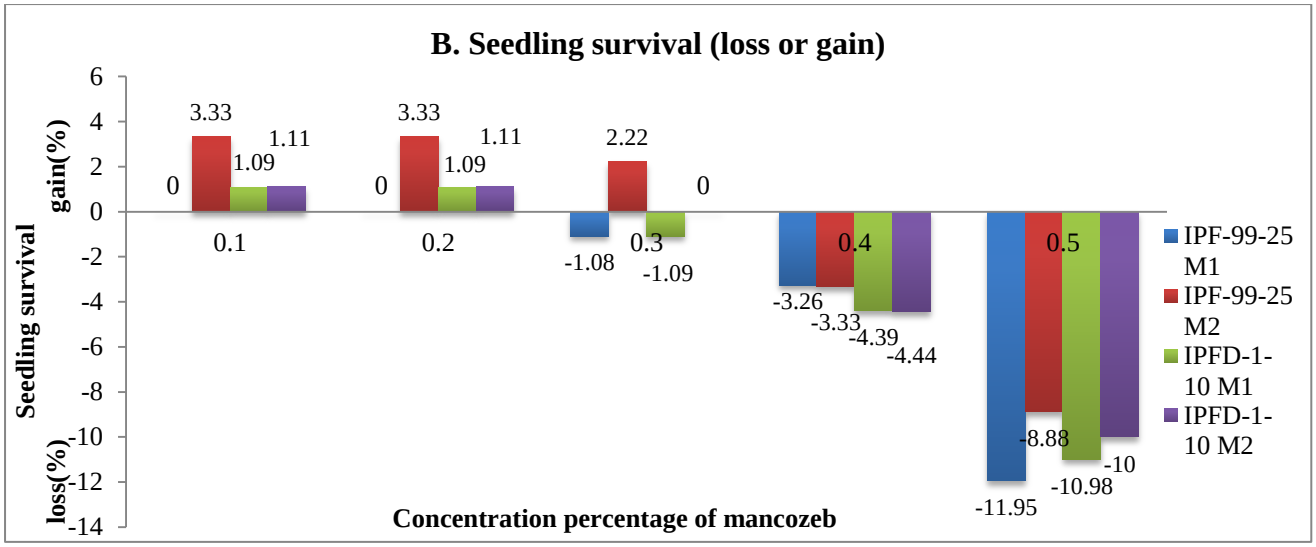

Figure 2: Percentage variation in seedling survival of *Pisum sativum* treated with Mancozeb in respect to control in M_1 & M_2 generation

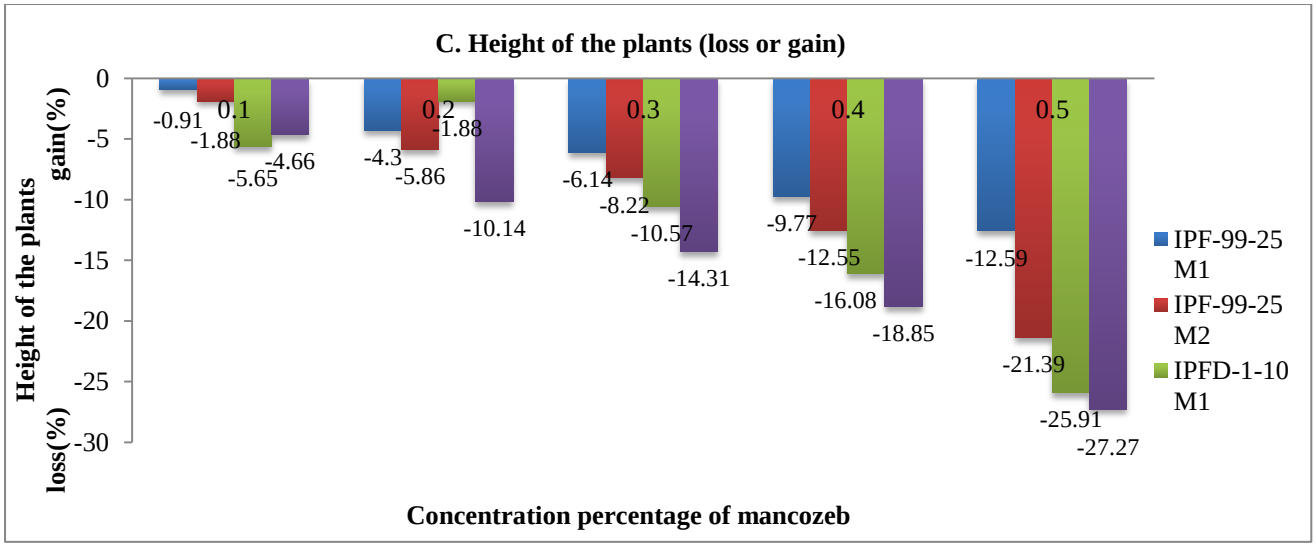

Figure 3: Percentage variation in height of *Pisum sativum* treated with Mancozeb in respect to control in M_1 & M_2 generation

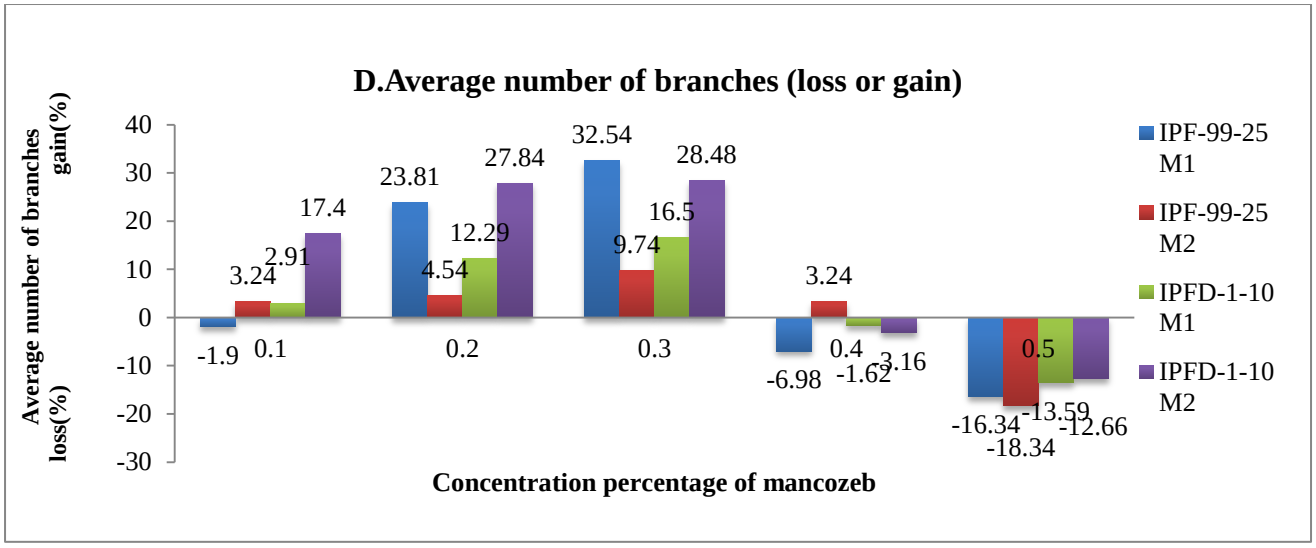

Figure 4: Percentage variation in no. of branches of *Pisum sativum* treated with Mancozeb in respect to control in M_1 & M_2 generation

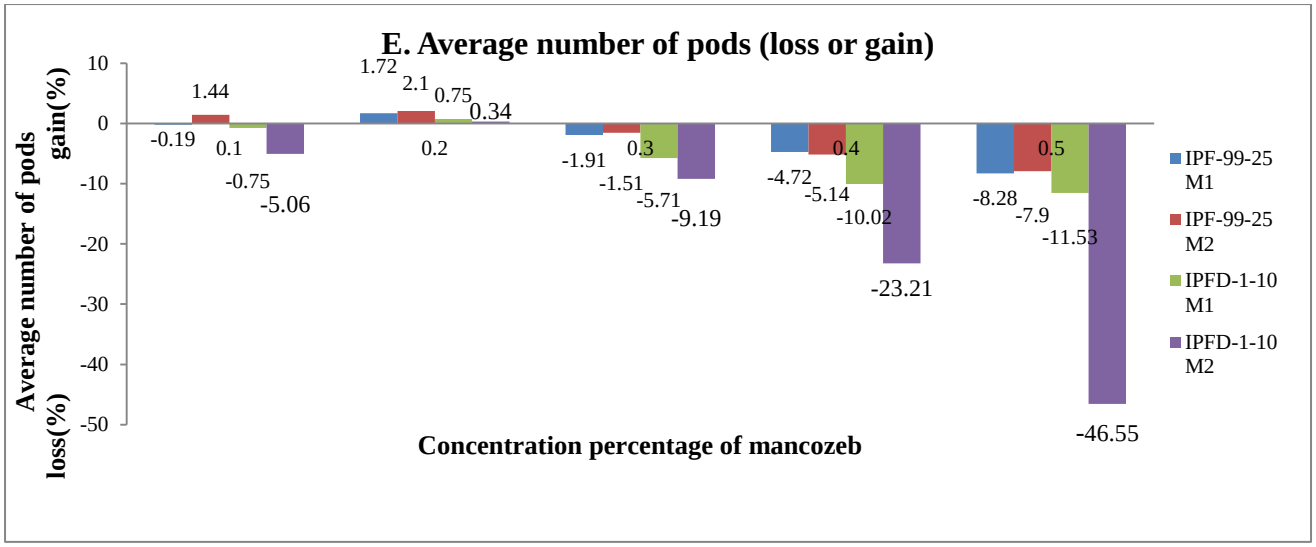

Figure 5: Percentage variation in no. of pods of *Pisum sativum* treated with Mancozeb in respect to control in M_1 & M_2 generation

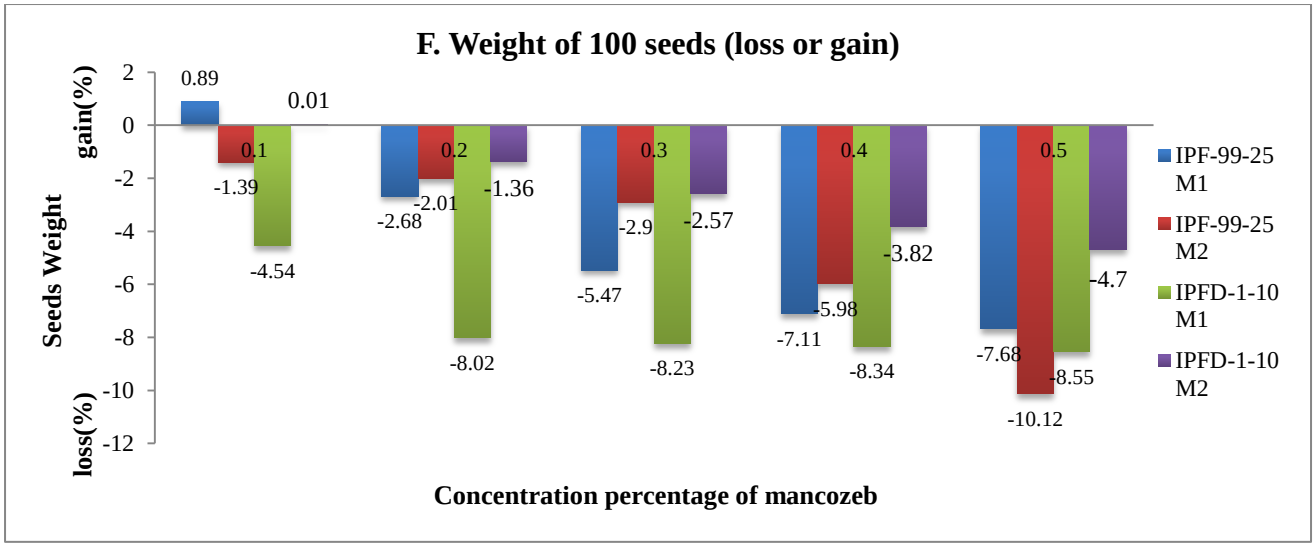

Figure 6: Percentage variation in weight of 100 seeds of *Pisum sativum* treated with Mancozeb in respect to control in M_1 & M_2 generation

Effect On Seedling Survival

In varieties IPF-99-25, the seedling survival percentage are 92%, 92%, 91%, 89% & 81% in M_1 generation & 93%, 93%, 92%, 87%, 82% in M_2 generation among 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration of mancozeb treated seed respectively.

In variety IPFD-1-10, the seedling survival percentage are 92, 92, 90, 87 & 81 in M_1 generation and 91, 91, 90, 86 & 81 in M_2 generation among 0.1%, 0.2%,0.3%,0.4% & 0.5% treatment concentration of mancozeb treated seeds respectively.

The seedling survival percentage in control are 92 & 90 in M_1 generation and 91 & 90 are in M_2 generation in varieties IPF-99-25 & IPFD-1-10 respectively.

Thus the seedling survival is a little better upto 0.2% treatment concentration of mancozeb treated seeds in comparison to control in both varieties in both generations. The toxic effects appear above 0.3% treatment concentration of mancozeb treated seeds in both varieties which increases with increase in treatment concentration (Fig. 2).

Effect On Height of The Plant

In variety IPF-99-25 (Adarsh) in M_1 generation, average height of plants are 204.50 cm, 197.5 cm, 193.70 cm, 186.22 cm and 180.44 cm in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% concentration treatment of mancozeb respectively in comparison to 206.39 cm in control . In

M_2 generation, the value for the same criteria are 203.79 cm, 195.51 cm, 190.61 cm, 181.63 cm and 163.27 cm respectively in comparison to 207.70 cm in control. While in variety IPFD-1-10 (Prakash) in M_1 generation, average height of plants are 102.42 cm, 106.5 cm, 98.17 cm, 91.09 cm and 80.42 cm in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% concentration treatment of mancozeb respectively in comparison to 108.55 cm in control . In M_2 generation, the value for the same criteria are 102.07 cm, 96.20 cm, 91.73 cm, 86.87 cm and 77.86 cm respectively in comparison to 107.06 cm in control.

Thus, the toxic effects on average height of the mature plants begins even from 0.1% treatment concentration of mancozeb in both varieties which increases with increase in treatment concentration. The height reduces upto 21% in variety IPF-99-25 & upto 27%. In variety IPFD-1-10 in 0.5% treatment concentration of mancozeb in comparison to control (Fig.3).

Effect On Number of Branches Per Plant

In variety IPF-99-25 (Adarsh), the average number of branches is found to be 6.18, 7.80, 8.35, 5.86 and 5.27 in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% concentration treatment of mancozeb respectively in comparison to 6.30 in control in M_1 generation. Similarly in M_2 generation, the value for the same criteria are 6.36, 6.44, 6.76, 5.96 and 5.03 respectively in comparison to 6.16 in control. In variety IPFD-1-10, the average number of branches are 3.18, 3.47, 3.6, 3.04 and 2.67 in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% concentration treatment of mancozeb respectively in comparison to 3.09 in control in M_1 generation. In M_2 generation, the value for the same criteria are 3.71, 4.04, 4.06, 3.06, and 2.76 respectively in comparison to 3.16 in control.

Above discussion clearly reflect inducive effect on average no. of branches upto 0.3% treatment concentration of mancozeb. The number of branches increases with increase in treatment concentration from 0.1% to 0.3% of mancozeb. Thereafter, toxic effect began and no. of branches reduces with increasing the treatment concentration above 0.3% (Fig.4).

Effect On The Initiation of Flowering

No significant effect is observed in both varieties in both generations in comparison to control among survived plants.

Effect On Period of Harvesting

No. significant effect is observed regarding period of harvesting in comparison to control in both varieties in both generations among survived plants.

Effect On Number of Pods Per Plant

The average number of pods per plant in variety IPF-99-25 are 15.66, 15.96, 15.39, 14.95 and 14.39 in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration of mancozeb respectively in comparison to 15.69 under control in M_1 generation. In M_2 generation, the average number of pods per plants are 15.40, 15.5, 14.95, 14.40 and 13.98 in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration respectively in comparison to 15.18 under control. However, the average no.of pods per plants in variety IPFD-1-10 are 9.21, 9.35, 8.75, 8.35 and 8.21 in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration of mancozeb respectively in comparison to 9.28 under control in M_1 generation. In M_2 generation, the average number of pods are 8.26, 8.73, 7.90, 6.68 and 4.65 in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration of mancozeb respectively in comparison to 8.7 under control in M_2 generation.

The toxic effects begins from 0.3% treatment concentration of mancozeb. The no. of pods/ plant reduce upto 8.28% in variety IPF-99-25 and upto 46% in variety IPFD-1-10 in 0.5% treatment concentration of mancozeb in comparison to control. Thus variety IPFD-1-10 is comparatively more susceptible to mancozeb than variety IPF-99-25 (Fig.5).

Effects On Weight of The Seeds

In variety IPF-99-25, the average weight of 100 seeds are 19.16 gram, 18.48 gram, 17.95 gram, 17.64 gram and 17.53 gram in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration of mancozeb respectively in M_1 generation. In M_2 generation, average weight of 100 seeds are 17.62 grams, 17.51 gram, 17.35 grams, 16.80 gram and 16.06 gram in 0.1%,0.2%0.3%, 0.4% and 0.5% treatment concentration of mancozeb respectively. While in control, it is 18.99 gram & 17.87 gram in M_1 & M_2 generation respectively. However, the average weight of 100 seeds in variety IPFD-1-10 are 17.85 grams, 17.20 gram, 17.16 gram, 17.14 gram and 17.10 gram in 0.1%, 0.2%, 0.3%, 0.4% and 0.5% treatment concentration of mancozeb respectively in M_1 generation. In M_2 generation, the average weight of 100 seeds are 18.29 gram, 18.03 gram, 17.81 gram, 17.58 gram and 17.42 gram in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration of mancozeb respectively. While in control, it is 18.70 gram & 18.28 gram in M_1 and M_2 generation respectively.

Thus the significant toxic effects on average seed weight begins from 0.3% treatment concentration of mancozeb in both varieties in both generations which increases with increase in the treatment concentration of mancozeb (Fig.6).

The experiment was done to assess the toxicity of mancozeb on growth parameters, reproduction & yield of *Pisum sativum* (Pea) taking its two varieties IPF-99-25 & IPFD-1-10. On the basis of above observations and discussion, we can conclude that *Pisum sativum* may tolerate the toxic effects upto 0.3% concentration of mancozeb. Upto 0.3% treatment concentration of mancozeb may also induce branching. However above 0.3% concentration of mancozeb have toxic effects on all parameters of growth, reproduction & yield. Toxic effect showed increasing trends with increasing in the concentration of mancozeb above 0.3% and yield also decreases. It may also badly affect the human health through bio-magnifications. The farmers may utilize upto 0.3% concentration of mancozeb safely to control fungal diseases.

REFERENCES

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.

Aamil M., Zaidi A. and Khan M.S., 2004. Fungicidal impact on Chickpea-Mesorhizobium Symbiosis. Journal of Environmental Science and Health, Part B, **39**(5-6): 779-790.

Buts A.K., Singh D., Choudhry V.L. and Singh M., 2013. Effects of bavistin on seed germination, morphological features and yield of *Vigna radiata*. Indian Journal of Life sciences **3**(1):15-20.

Buts A.K., Singh M. and Singh D., 2016. Effects of bavistin on germination, growth & yield of *Abelmoschus esculantus* (okra). Nature & Environment, **21**(1):60-68.

Casida J.E., 2009. Pest Toxicology: The Primary Mechanisms of Pesticide Action. Chemical Research in Toxicology, **22**(4): 609–619.

Dahl W.J., Foster L.M. and Tyler R.T., 2012. Review of the health benefits of peas (*Pisum sativum* L.). British Journal of Nutrition, **108 Suppl 1**:S3-10.

Jadon K.S., Thirumalaisamy P.P., Kumar V., Koradia V.G. and Padavi R.D., 2015. Management of soil borne diseases of groundnut through seed dressing fungicides. Crop Protection, **78**: 198–203.

Khan I.A., Khan H., Ali A., Raziq F., Hussain S., Ahmad M. and Attauddin, 2009. Evaluation of various fungicides and cultivars for the control of pea rust under natural conditions. Sarhad Journal of Agriculture, **25(2):** 261-268.

Kumar P., Kumar S., Thakur B. and Paul, Y., 2012. Effect of fungicides and bioagents on root rot/wilt complex of pea in Lahaul valley -A cold desert area of Himachal Pradesh in north western Himalayas. Plant Disease Research, **27:** 186-189.

Monika and Kidwai M.K., 2017. Effect of mancozeb on mustard (*Brassica juncea L.*): An In-vitro study. Town Planning Review, **4:** 55-61.