Nature & Environment
Vol. 21 (1), 2016: 60-68
Website: www.natureandenvironment.com

ISSN (Print) : 2321-810X
ISSN (Online) : 2321-8738

RESEARCH ARTICLE

Effect of Bavistin on Germination, Growth and Yield of *Abelmoschus esculentus* (OKRA)

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Received: 12th September 2015, Revised: 24th December 2015, Accepted: 27th December 2015

ABSTRACT

The experiment was conducted to asses the effect of Bavistin on germination, growth and yield of Abelmoschus esculentus up to two generation selecting variety Chyan bhindi. The seeds were treated with 0.1%, 0.2%, 0.3%, 0.4% & 0.5% concentration of Bavistin before sowing in the experimental plot and resulting plants were considered as M_1 generation. Seeds obtained from M_1 generation under different concentration treatment were again treated with corresponding concentration of Bavistin to obtain M_2 generation. The result showed an increase in germination percentage, seedling survival percentage, height of plants and weight of seeds up to 0.3% treatment concentration in both generation. 0.4% treatment concentration induces a little more branching however average number of pods per plant showed decreasing trends with increasing the treatment concentration under taken for study. 0.4% and 0.5% treatment concentration of Bavistin showed increasing trends of deleterious effect with increasing the treatment concentration with respect to germination percentage, seedling survival percentage, height of plants, no. of pods per plant and weight of seeds in both M_1 & M_2 generations. As up to 0.3% treatment concentration of Bavistin showed positive impact on growth parameters taken for study on Abelmoschus esculentus except no. of pods per plant in both M_1 & M_2 generation, therefore, farmers can use bavistin up to 0.3% concentration to control disease. 0.4% and above treatment concentration showed increasing trends of deleterious effect with increasing the treatment concentration on growth and yield.
Key words: *Abelmoschus esculentus, Bavistin, germination, Growth, Yield*

INTRODUCTION

Vegetables are important constituent of Indian's diet. They are rich source of vitamins, minerals and plant fibers required for human health. Most of the vegetables are short duration crop and produces higher return per unit area & time. That's why vegetables are economically viable for farmers.

Abelmoschus esculentus (okra) is an important summer & rainy season vegetable crop. India is largest producer of okra sharing about 67.1% of the world production. Its young fruits are used as a vegetable which contains protein, carbohydrate, vitamin-C, antioxidants & anti-diabetic properties. It is a very popular, tasty and gelatinous vegetable. The mucilage obtained from okra is usually used for glace paper production and also has confectionery use (Akinyele and Temikotan, 2007).

Savello *et al* (1980), Markose and Peter(1990), Lengsfeld *et al* (2004), Adetuyi *et al* (2008), Kumar *et al* (2010) reported that okra has found medical application as a plasma replacement or blood volume expander. Seed of okra is also a source of oil.

F. Anwar (2010) found okra oil suitable for bio-fuel. The fibers obtained from okra stem are used in paper making & textiles. Many varieties of okra are susceptible to several infectious diseases. Many fungicides and insecticides are used to control these diseases.

Use of agrochemical is the integral part of the current agricultural production system around the world. These are used to increase yield. High uses of agrochemical in vegetable production not only affect the quality but also the taste.

Jalilian *et al* (2000) reported the cytogenetic effect of pesticides. The presence of their residues in fruits and vegetables can be a significant route to human exposure.

In agriculture, fungicides are used to protect tubers, fruits and vegetables during storage or are applied directly to ornamental plants, trees, field crops, cereals and turf grasses. Several workers have identified elements of unsafe use of pesticides as lack of attention to safety precautions, environmental hazards and information about first aid and anti-dots given by the labels, the use of faulty and proper maintenance of spraying equipment and lack of the use of protective gear and appropriate clothing during handling of pesticides (Damalas *et al*, 2006; Ajayi and Akinnifesi, 2007; Sosan and Akingbohungbe, 2009).

Several workers reported that certain environmental chemicals including pesticides termed as endocrine disruptors are known for their adverse effect by mimicking and antagonizing natural hormone in the body and it has been postulated that their long term low dose exposure are increasingly linked to human health effect such as immunosuppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer (Crisp *et al*, 1998; Hurley *et al*, 1998).

Ganesh *et al* (2006) determine the effect of bavistin (50, 100, 200, 300, 400, 500 & 600 mg/litre) on seed germination and growth of rice cultivars ASD-16 & IR-36. Buts *et al* reported about effect of dithane M-45 on growth and development of *Abelmoschus esculentus*. Ashok Aggarwal *et al* (2005) reported that the growth of sunflower decreased with increasing the concentration of bavistin & dithane M-45. Highest decrease in growth was observed in 1% concentration.

Thus many workers have reported about health hazards, environmental pollution & other undesirable side effect caused by the continuous use of synthetic chemical pesticides. The present study was done to evaluate the effect of bavistin on germination, growth and yield of *Abelmoschus esculentus* during their whole life cycle up to two generation in field condition. Parameters taken for study are seed germination, seedling survival, plant height, no. of branches, days taken for initiation of flowering, no. of pods per plant and weight of seeds.

MATERIAL AND METHODS

Abelmoschus esculentus (okra) belongs to family malvaceae. It is a polyploid with 2n=8x=72 to 144 chromosomes. Seeds of *Abelmoschus esculentus* variety Chyan bhindi were obtained from Saac Sabji Anusandhan Kendra, kanpur. Prior to the experiments, healthy seeds of equal size and shape were selected for treatment with bavistin.

Bavistin is broad spectrum systematic carbamate fungicide, light gray powder, soluble in water hexane, ethanol, dichloromethane, slowly decomposed in alkaline solution.

Before sowing of seeds in experimental plot, seeds were soaked in distilled water overnight. Then soaked 100 seeds were placed in petridishes containing concentration of 0.1%, 0.2%, 0.3%, 0.4% & 0.5% for 6 hours in the laboratory and after treatment, these seeds were allowed to germinate in petridishes lined with filter paper and cotton wool. After radicle emergence, they were sown in the experimental plot under control conditions. 100 seeds soaked in distilled water for overnight were sown in experimental field as control. The seeds were sown in lines keeping a distance between rows was 75-80 cm. Distance between rows will provide space for ease in movement during spraying, side dressing & harvesting. On the contrary, in the field, the emergence of hypocotyle & cotyledons above the surface of the soil has been taken as index of germination. Arrangement was made for regular operation & irrigation. Neither chemical nor any fertilizer was used. This was done to avoid confusion. In the field, the seeds were sown in the first week of July and harvesting was done during the period of November. In between that period, morphological characters were studied with respect to plant height, date of first flowering, no. of pods per plant etc.

The seeds were collected after harvesting in glass containers separately with specific symbols. On maturity, weight of 100 seeds was taken from control as well as treated plants and seed quality was also observed. The stored seeds of M_1 generation were again treated with the corresponding concentration i.e. 0.1%, 0.2%, 0.3%, 0.4% & 0.5% of bavistin with the same method as mentioned above for M_1 generation. The morphological characters as well as yield were observed like M_1 generation. The phenotypic variability and their frequencies were collected. Finally the rate of induced variability of quantitative characters in M_1 and M_2 generation were calculated.

RESULTS AND DISCUSSION

Result obtained in the present study have been shown in table 1 & 2 and Graph 1-6 and expressed together with discussion in separate heading as:

Table 1: Effect of Bavistin on quantitative characters of *Abelmoschus esculentus* variety Chayan bhindi in M_1 generation

Treatment	Germination % in field	Seedling survival % in field	Height of native plants (m) ±S.D.	No. of branch per plant ± S.E.	Days taking 1st flowering	Period of harvesting	No. of pods per plant ±S.D.	Weight of 100 seeds (gram) ±S.D.
Control	84	80	0.81 ±0.20	Nil	48-55	58-113	16.7 ±8.87	4.859± 0.148
0.1%	84	81	0.822 ±0.16	Nil	48-55	57-113	14.1 ±3.61	5.402± 0.8597
0.2%	85	81	0.88 ±0.15	0.13 ±0.04	47-55	56-113	13.9 ±5.64	5.194± 0.8526
0.3%	88	83	1 ±0.28	0.14 ±0.10	48-55	58-113	13.8 ±1	5.149± 0.14039
0.4%	84	80	0.78 ±0.11	Nil	48-55	59-113	13.5 ±3.71	4.795± 0.05648
0.5%	82	76	0.68 ±0.23	Nil	48-55	59-113	13.4 ±4.15	4.65± 0.0496

Table 2: Effect of Bavistin on quantitave characterr of *Abelmoschus esculentus* variety Chyan bhindi in M_2 generation

Treatment	Germination % in field	Seedling survival % in field	Height of native plants (m) ±S.D.	No. of branch per plant ± S.E.	Days taking 1st flowering	Period of harvesting	No. of pods per plant ±S.D.	Weight of 100 seeds (gram) ±S.D.
Control	85	82	0.81 ±0.20	Nil	49-56	57-120	18 ±3.5	5.276± 0.09445
0.1%	85	82	0.83 ±0.15	Nil	49-56	57-120	16.20 ±3.51	5.307± 0.07443
0.2%	84	82	0.93 ±0.12	0.06 ±0.02	49-56	57-120	16.00 ±3.81	5.191± 0.09945
0.3%	86	83	1.0 ±0.23	0.17 ±0.09	49-56	57-120	15.4 ±2.74	4.755± 0.08503
0.4%	83	80	0.79 ±0.13	Nil	49-56	57-120	14.0 ±3.26	4.689± 0.1342
0.5%	81	76	0.68 ±0.18	Nil	49-56	57-120	13.4 ±2.65	4.663± 0.06812

EFFECT OF BAVISTIN ON SEED GERMINATION

In M_1 generation, the average seed germination were 84%, 85%, 88%, 82% & 82% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 84% under control. In M_2 generation, the average seed germination were 85%, 84%, 86%, 83% & 81% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 85% under control.

Therefore, there is an increase in the germination percentage up to 0.3% treatment concentration of bavistin in both M_1 & M_2 generation. Further with increasing the treatment concentration above

0.3%, there is a decreasing trend with increasing the treatment concentration of bavistin (Graph1). This finding resemble with the finding of Mashooda Begum and S. Lokesh (2008), Dey *et al* (1988).

EFFECT OF BAVISTIN ON SEEDLING SURVIVAL

In M_1 generation, the average seedling survival of chyan bhindi were 81%, 81%, 83%, 80% & 76% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration of bavistin in comparison to 80% of untreated seeds. In M_2 generation, it were 82%, 82%, 83%, 80% & 76% in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 82% of untreated seeds.

Therefore, Bavistin @ 0.3% treatment concentration increased the seedling survival in both M_1 and M_2 generation. Further increase in treatment concentration decreased the seedling survival (Graph2). This finding corroborate with Sharma *et al* (2005).

EFFECT OF BAVISTIN ON PLANT HEIGHT

Plant height was recorded at the time of maturity on earlier tagged all plants in each treatment. The height was measured from ground level to the point of peduncle and expressed in meter. In M_1 generation, the average plant height of chayan bhindi were 0.82m, 0.88m, 1m, 0.78m & 0.68m in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 0.81m under untreated seeds. In M_2 generation, the average plant height were 0.83m, 0.93m, 1.0m, 0.79m & 0.68m in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 0.81m under untreated seeds.

Thus, there is an increase of 1.48%, 8.64% & 23.45% in 0.1%, 0.2% & 0.3% treatment concentration treated seeds in terms of height in comparison to untreated seeds while there is a decrease of -3.70% & -16.04% in 0.4% & 0.5% treatment concentration treated seeds in M_1 generation. The same trends are observed in M_2 generation also (Graph 3).

Therefore it can be concluded that there is a positive effect in terms of height up to 0.3% treatment concentration of bavistin in comparison to control in okra however above 0.3% treatment concentration have negative effect in both generations. The most adverse effect is observed in 0.5% treatment concentration treated seeds. These finding are corroborate with the Ashok Aggarwal (2005) & Buts *et al* (2014) who observed that as the concentration of the fungicide increased, the growth decreased and minimum growth was observed in 1% concentration of dithane M-45.

EFFECT OF BAVISTIN ON NUMBER OF BRANCHES

In both M_1 and M_2 generation 0.2% & 0.3% treatment concentration of bavistin induced a little branching and branch formation was not found in 0.1%, 0.4% & 0.5% treatment concentration treated as well as untreated seeds in both generation of chayan bhindi (Graph 4). The result obtained is insignificant. Hence, it can be concluded that there is no major effect of bavistin on branching in *Abelmoschus esculentus* i.e. okra plants.

EFFECT OF BAVISTIN ON FIRST FLOWERING

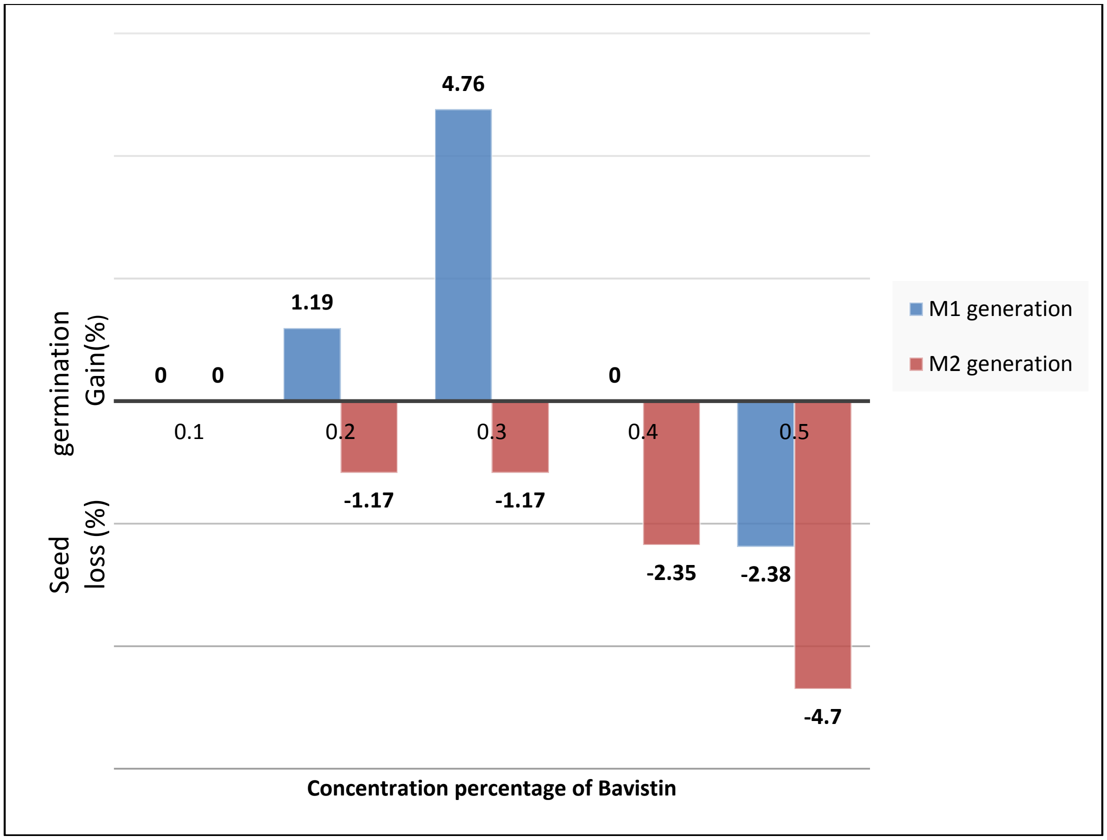
There was no significant change in the no. of days for initiation of flowering in both M_1 and M_2 generation variety chayan bhindi of *Abelmoschus esculentus.*

EFFECT OF BAVISTIN ON HARVESTING

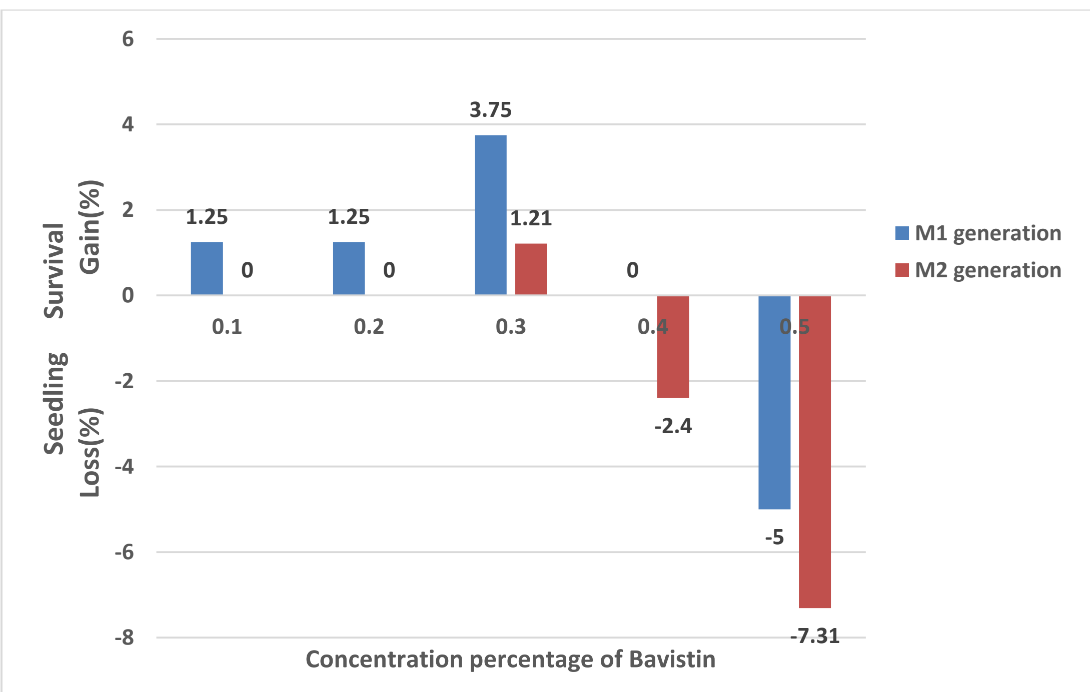
There was no significant change in period of harvesting in comparison to control.

EFFECT OF BAVISTIN ON NUMBER OF PODS PER PLANT

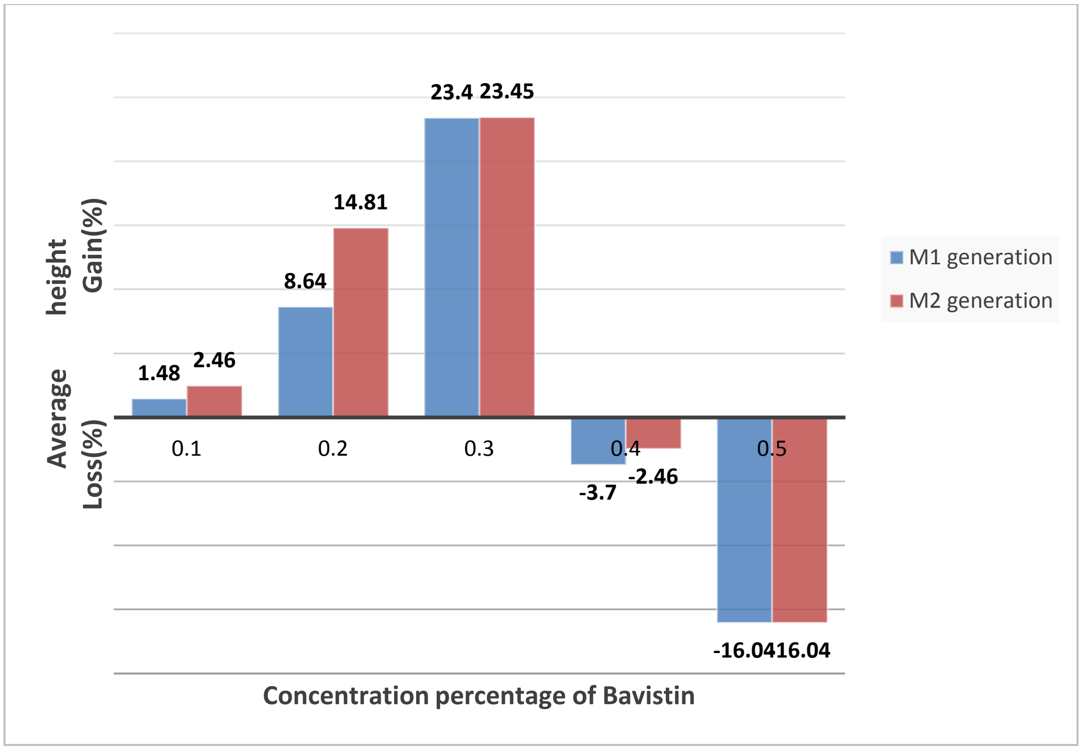
In M_1 generation, the average no. of pods per plant is 14.1, 13.9, 13.8, 13.5 & 13.4 in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 16.7 under control. In M_2 generation, the average no. of pods is 16.2, 16.0, 15.4, 14.0 & 13.4 in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration respectively in comparison to 18 under control.



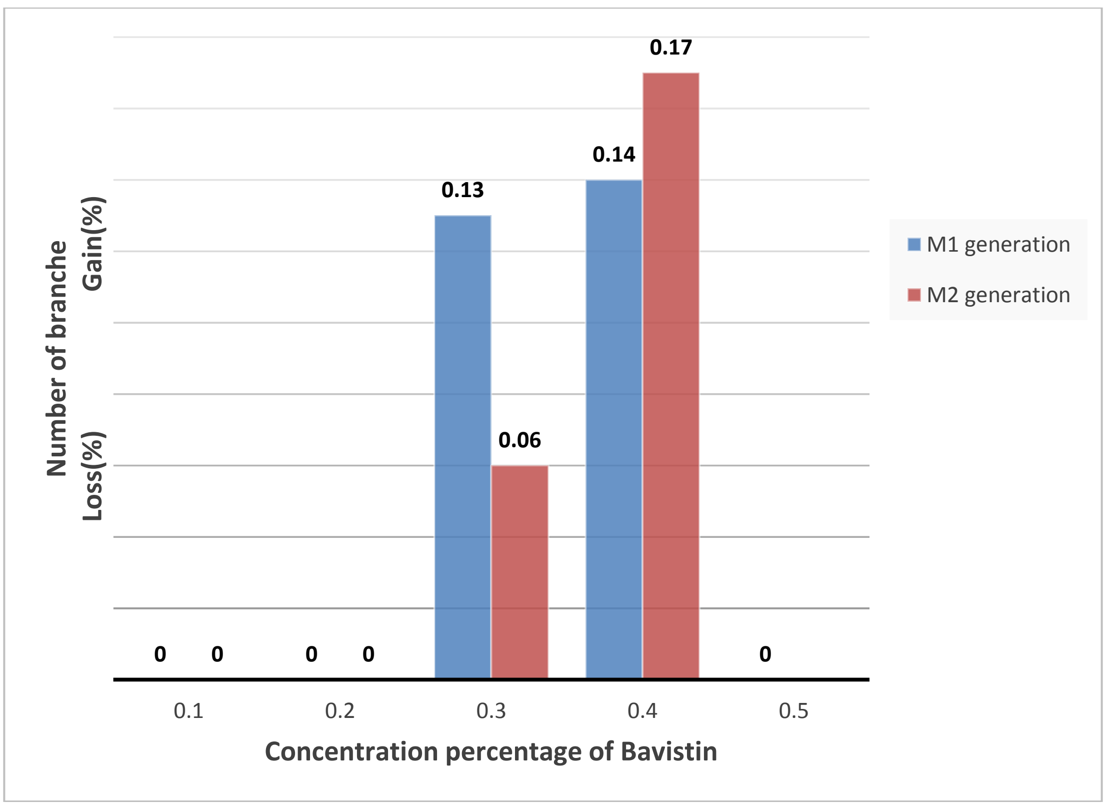
Graph 1: Average seed Germination (loss or gain)



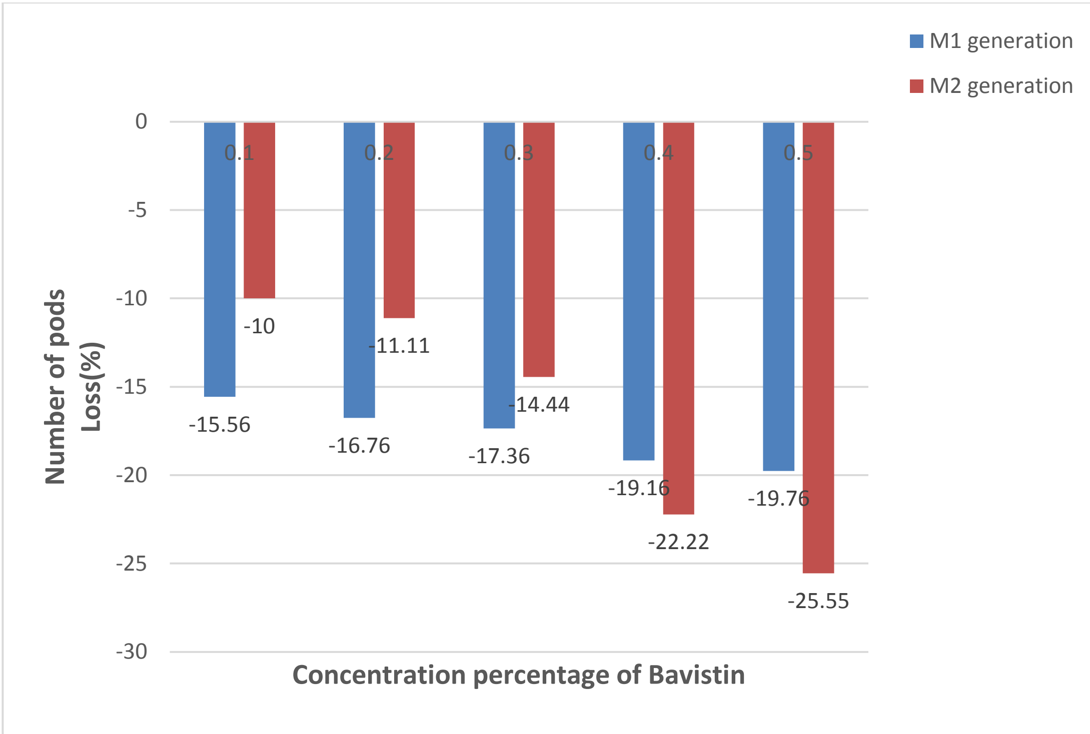
Graph 2: Average Sedling Survival (Loss or Gain)



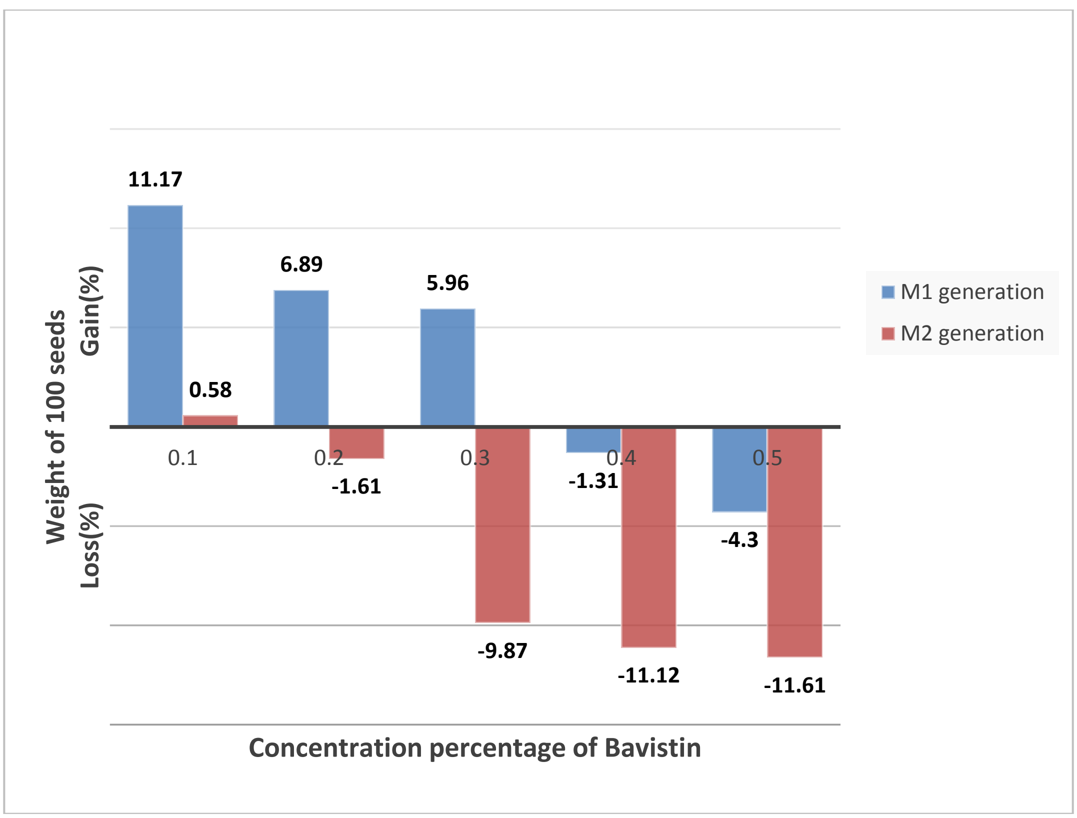
Graph 3: Average height (Loss or Gain)



Graph 4: Average no. of branches (loss or gain)



Graph 5: Average no. of pods per plant (Loss or Gain)



Graph 6: Average weight of 100 seeds (Loss or Gain)

Thus, remarkable variations in number of pods per plant at different strength of bavistin used were observed. The decline percentage in the average no. of pods per plant were 15.56%, 16.76%, 17.26%, 19.16% & 19.76% in M_1 generation and 10%, 11.11%, 14.44%, 22.22% & 25.53% in M_2 generation among 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration treated plants respectively (Graph 5). Therefore it can be safely concluded that the no. of pods per plant formation showed declining trends with increasing the treatment concentration of bavistin. But reduction in pod formation was less in M_2 generation than M_2 generation in corresponding treatment concentration. This happens probably due to development of a short of tolerance capacity towards the treatment concentration.

EFFECT OF BAVISTIN ON WEIGHT OF 100 SEEDS

Seeds collected from different population of variety chayan bhindi of *Abelmoschus esculentus* raised from the seeds treated with different concentration of bavistin were preserved with precautions. Random selections of 100 seeds were done and its weight was taken. In M_1 generation, the average weight of 100 seeds are 5.402gm, 5.194gm, 5.149gm, 4.795gm & 4.65gm in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration treated respectively in comparison to 4.459gm in control. In M_2 generation, the average weight of 100 seeds are 5.307gm, 5.191gm,4.755gm, 4.689gm &4.663gm in 0.1%, 0.2%, 0.3%, 0.4% & 0.5% treatment concentration treated respectively in comparison to 5.276gm under control. Thus there is an increase of 11.17%, 6.89% & 5.96% in M_1 generation in 0.1%, 0.2% & 0.3% treatment concentration. Thereafter all the treatment concentration under taken in M_2 generation and 0.4% & 0.5% treatment concentration in M_1 generation showed decrease in the weight of seeds. The maximum decline in weight of seeds occurs in 0.5% treatment concentrations which were 4.3% & 11.61% in M_1 & M_2 generation (Graph6).

On the basis of the above observations and discussion in the present investigation, it can be concluded that up to 0.3% treatment concentration of bavistin have positive impact on growth characters & is safe for farmer's use. As no. of pods per plant & weight of seeds together decides yield, the treatment concentration more than 0.3% of bavistin deleteriously affect crop and reduces yield. Therefore the obtained result suggests limited use of bavistin in very low concentration i.e. up to 0.3% for treatment.

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