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Effect of Some Pesticides (Fungicides) on the Germination and Growth of Seeds/Seedlings of Some Crop Plants, (i.e. *Cicer arietinum* and *Zea mays*)

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Abstract: The present study was carried out in relation to treatment of the seeds *Cicer arietinum* and *Zea mays* with various concentrations of fungicides. Effect of fungicides on the seed germination, growth and biomass production of *Cicer arietinum* and *Zea mays* were observed in *vitro*. The fungicides (i.e. Captan, Bavistin, Domarck, Blitox and Sitara) solution for growing the seeds with the following concentrations were used; 1 ppm, 10 ppm, 50ppm and 100 ppm were taken to observe their growth promoting/ inhibiting effects on the Maize and gram seeds on their germination and growth (radicle and plumule). The data obtained indicates that germination percentage of seeds and biomass production were slightly affected with the differences in the two crops under investigation. The fungicide Bavistin (Carbendazim) at 10 ppm concentration was the best among the treatments of *Cicer arietinum* while in case of *Zea mays*, 1ppm concentration of Bavistin (Carbendazim) has shown better stimulating effect on the seed germination and plant growth (radicle and plumule) as compared to Control. Significant differences in the growth values of seeds between treated and control plants were observed.

Key words: *Cicer arietinum* · Fungicides · Plumule · Radicle · Seed Germination · Seedling growth · *Zea mays*

INTRODUCTION

In recent years concern over problems associated with pesticide use has often been discussed. Substantial contribution to the residue of pesticides that mainly include insecticides, fungicides and herbicides derives from spraying and seed dressing. Although protection of seeds and seedlings from pests and disease organisms is the prime aim of seed treatment, secondary affects on the germination and growth are more likely to occur from seed treatments as well as from accumulated residues resulting from repeated use of pesticides.

Pesticides represent the only group of chemicals that are purposely applied to the environment with an aim to suppress plant and animal pests and to protect agricultural and industrial products. However, the majority of pesticides do not specifically target the pest only and during their application they also affect non-target plants and animals. The term pesticides cover a wide range of compounds including insecticides, herbicides, rodenticides, molluscides, nematocides, plant growth regulators and others.

Numerous researchers have reported on the adverse affects of pesticides on the germination and growth of the crop plants. Agriculture is the main destination for chemicals [1]. Seeds are considered to be as a suitable host to maintain the pathogenic microorganisms even in the absence of the host. Treating such seeds with fungi- or bactericides will protect them from being attacked by fungi, nematodes or other pests [2]. Treating vegetable and crops seeds with fungicides will protect them against soil-borne fungi which could cause diseases, especially root-rot [3]. With the wide increase of the use of such chemicals, it was found that they have harmful effect on human, animals, plants and microorganisms. Therefore, there was a crucial need to study their toxicity to plants.

Systemic pesticides may inhibit the growth of the petunias substantially and inhibit the plants from blossoming. So, it was proved that the ingredients in some systematic pesticides may inhibit the growth and

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development of plants [4]. Some pesticides have been reported to affect the plant growth, root nodulation and chlorophyll content of chickpea [5]. Different concentrations viz, 5, 10, 25, ppm of aldicarb, carbofuran, phorate fensulfothin and fevamiphos were observed for pesticidal effect on plant growth, it was observed that different concentrations have shown highly phototoxic effects. Saeidi and Mirik [6] in their study on flax seed treated with Captan 0.2% and Carbendazim 0.15% they reported that seed germination was not significantly affected except for some seeds after long storage periods.

Keeping the above in view the present work has been taken up to observe the effects of some selected pesticides in different concentrations on the germination, growth (radicle and plumule) and the production of biomass of some crop seeds/seedlings.

MATERIALS AND METHODS

Collection of Seeds: Seeds of both Maize (*Zea mays*) and gram *(Cicer arietinum)* were collected from the vendor. Seeds were carefully selected with no apparent infections/ damage.

The seeds of *Zea mays* and the *Cicer arietinum* were surface sterilized with 2 % sodium hypochloride for 15 minutes. The solution of 5 pesticides, *viz*., Captaf, Bavistin, Blitox (Copper oxychloride), Sitara (Hexaconazole) and Domarck (Tetraconazole) were prepared at different concentrations. Then the selected seeds of *Zea mays* and *Cicer arietinum* were soaked overnight (i.e. 24 hours) in different beakers containing the test solution of various concentrations. For germination, the treated seeds were placed uniformly in sterilized Petri- dishes lined with double layer of blotting paper and wetted with 10ml of different concentration of the pesticide test solution. Three replicates for each of the treatment including control was maintained. For each replicate 10 nos. of treated seed were used, so total no. of seeds used for each treatment has been 30 (10×30). One treatment was run as control and treated with distilled water only. All the Petri-dishes were maintained under room temperature. The seeds were kept under moist condition with the test solutions and equal volume (i.e. 10 ml) of distilled water. Water was added when the moisture content of the blotting paper declined. The number of seeds germinated in each treatment was counted at the end of the observation (i.e. 5th observation) days after sowing and the germination percentage was calculated. The germination percentage was calculated by using the following formula:

$$\text{Germination (\%)} \frac{\text{Number of seeds germinated}}{\text{Total Number of seeds planted}} \times 100$$

The radicle and plumule growth of the seedlings exposed to various concentrations of pesticide solution were measured with the help of a slide caliper for each germinating seed and the observations were made five times in two days interval. At the end of the experiment, all the radicle and plumule were harvested separately and oven dried at 70^{0}C or 48 hours to get the biomass of the same.

Statistical Analysis and Figure Representation: Analysis of variance (ANOVA) was computed by SPSS version 16.0 for growth parameters (radicle and plumule). Graph illustrations for germination and growth parameters are based on differences in mean values between the control and treated samples.

RESULTS

Effect of Pesticides on the Seed Germination and Seedling Growth of *Cicer Arietinum*

Effect on the Seed Germination: It can be seen in Table 2 represents the effect of pesticides viz, Captan, Carbendazim, Tetraconazole, Hexaconazole and Copper oxychloride on the germination of *Cicer arietinum* (gram). It is observed that *Cicer arietinum* gave 100% germination in all the concentrations viz, 1 ppm, 10 ppm, 50 ppm and 100 ppm of Captan and Carbendazim fungicide. And the concentrations 50 and 100 ppm of Tetraconazole showed the highest inhibitory effect on the germination.

Table 1: Fungicides used and its active ingredients and concentrations used

Sl. no	Trade name	Chemical name	Active ingredients	Concns. used
1	Captaf	Captan	50%WP contact fungicide	(1,10,50,100) ppm
2	Bavistin	Carbendazim	50% WP Carbendazim	(1,10,50,100) ppm
3	Blitox	Copper oxychloride	50%WP Copper oxychloride	(0.25,0.5,1)%
4	Sitara	Hexaconazole	5%EC	(0.25,0.5,1,2) ppm
5	Domarck	Tetraconazole	3.8% Tetraconazole EW	(1,10,50,100) ppm

Table 2: The effect of various concentrations of fungicides i.e Captan, Carbendazim, Copper oxychloride, Hexaconazole and Tetraconazole on the germination of *Cicer arietinum (gram seeds).*

Name of fungicides	Control	1 ppm	10 ppm	50 ppm	100 ppm
Captan	100.00	100.00	100.00	100.00	100.00
Carbendazim	100.00	100.00	100.00	100.00	100.00
Tetraconazole	96.66	90.00	36.66	00.00	00.00
Hexaconazole	96.66	100.00	96.66	100.00	93.33
Copper oxychloride	100	76.66	80.00	73.33	72.33
F test	235	378	126.99	564	660

Mean of 3 replicates, significant at $P < 0.05$

Table 3: Effect of fungicides on the production of biomass in the treated seedlings of *Cicer arietinum.*

Captan Treatment	Dry weight (in grams) Radicle weight	Plumule weight
Control	0.14	0.1
1 ppm	0.21	0.17
10 ppm	0.19	0.1
50 ppm	0.2	0.12
100 ppm	0.18	0.12
Carbendazim		
1 ppm	0.2	0.11
10 ppm	0.21	0.14
50 ppm	0.15	0.1
100 ppm	0.19	0.1
Copper oxychloride		
1 ppm	0.07	0.04
10 ppm	0.05	0.05
50 ppm	0.02	0.001
100 ppm		
Hexaconazole		
1 ppm	0.13	0.08
10 ppm	0.08	0.04
50 ppm	0.07	0.05
100 ppm	0.04	0.06
Tetraconazole		
1 ppm	0.04	0.04
10 ppm	0.04	0.05
50 ppm	0	0
100 ppm	0	0
F test	12.34	17.8

Mean of 3 replicates, significant at $P < 0.05$

Table 4: The effect of various concentrations of fungicides i.e Captan, Carbendazim, Copper oxychloride, Hexaconazole and Tetraconazole on the germination of *Zea mays (*Maize seeds).

	Germination percentage (%)				
	Concentrations				
Name of the Fungicides	Control	1 ppm	10 ppm	50 ppm	100 ppm
Captan	83.33	90.00	76.66	83.33	86.66
Carbendazim	86.66	96.66	90.00	86.66	86.66
Tetraconazole	80.00	23.33	70.00	46.66	26.66
Hexaconazole	80.00	66.66	73.33	56.66	76.66
Copper oxychloride	70.00	63.33	66.66	72.66	76.66
F test	121	178.66	325	129.6	98.55

Mean of 3 replicates, significant at $P < 0.05$

Effect of Pesticides on the Production of Biomass: Results in table 3 represents the effect of fungicides on the production of biomass in treated seedlings of gram seeds *(Cicer arietinum)*. It was observed that 1 ppm concentration recorded the biomass production having 0.21 g for radicle and 0.17 g for plumule respectively. The Captan fungicide showed slight biomass inhibition at higher concentration (i.e.50 ppm, 100 ppm) but showed growth promoting effect at lower concentration (1 ppm). Bavistin (10 ppm) has shown highest biomass production having 0.21 g for radicle and 0.14 g for plumule as compared to control, which have the biomass production of 0.14 g and 0.1 g for radicle and plumule, respectively. Copper oxychloride treatment exhibited very little biomass production in higher concentration (1%), i.e. 0.02 g for radicle and 0.001 g for plumule. Hexaconazole showed inhibitory effect on the production of biomass in the treated seeds/seedlings of *Cicer arietinum*.

Effect of Pesticides on the Seed Germination and Seedling Growth of *Zea mays*

Effect on the Seed Germination: It can be seen, in Table 4 the effect of pesticides viz, Captan, Carbendazim, Tetraconazole, Hexaconazole and Copper oxychloride on the germination of *Zea mays* (maize). It was observed that the best results were obtained with seeds treated with Bavistin (1 ppm) having 96.66% germination followed by Carbendazim 10 ppm and 1 ppm of Captan fungicides respectively having 90.00% germination. And 1ppm concentration of Tetraconazole showed the highest inhibitory effect (i.e. 23.33%) followed by 100 ppm giving 26.66% germination.

Effect of Pesticides on the Production of Biomass: It can be seen that of Bavistin at 10 ppm concentration has been the best in the production of biomass i.e.(0.57 g) for radicle and (0.33 g) for plumule (Table 5). Tetraconazole (100 ppm) exhibited the highest inhibitory effect on the production of biomass (i.e 0.03 g for radicle and 0.02 g for plumule). Among the pesticides used, Captaf and Bavistin

Table 5: Effect of fungicide on the production of biomass in the treated seedlings of *Zea mays.*

Treatment	Dry weight (in grams)	
Captan	Radicle weight	Plumule weight
Control	0.45	0.24
1 ppm	0.53	0.27
10 ppm	0.56	0.23
50 ppm	0.48	0.25
100 ppm	0.52	0.24
Carbendazim		
1 ppm	0.48	0.32
10 ppm	0.57	0.33
50 ppm	0.51	0.29
100 ppm	0.45	0.21
Copper oxychloride		
1 ppm	0.22	0.20
10 ppm	0.19	0.18
50 ppm	0.19	0.15
100 ppm		
Hexaconazole		
1 ppm	0.25	0.13
10 ppm	0.33	0.10
50 ppm	0.15	0.03
100 ppm	0.16	0.08
Tetraconazole		
1 ppm	0.09	0.05
10 ppm	0.25	0.14
50 ppm	0.05	0.03
100 ppm	0.03	0.02
F test	12.6	11.9

Mean of 3 replicates, significant at $P < 0.05$

indicates to be having the highest growth promoting effect and Blitox, Hexaconazole and Tetraconazole application showed the highest inhibitory effect on the production of biomass in case of *Zea mays*.

DISCUSSION

It has been observed that the use of pesticide cause serious detrimental effect on the seed germination and seedling growth. The pesticides used in the study viz., Captaf, Bavistin, Blitox, Sitara and Domarck have inhibitory effect as well as growth promoting effect on the germination and seedling growth of radicle and plumule of *Cicer arietinum* and *Zea mays*. In both the cases of *Cicer arietinum* and *Zea mays*, Carbendazim has shown the highest growth promoting effect on the germination and growth of radicle and plumule. The improvement in growth parameters may be because of its application suppressed and /or elimination of pathogenic population and the other factors. Growth stimulation may also be due to the increase in the growth promoting factors i.e increase in cytokinin or gibberellins production etc. Plant growth is affected by an osmotic shock effect of systemic pesticides which cause release in structural protein and loss of transportability in the leaf cells [7]. Likewise the possibility of the inhibition of protein synthesis, a decrease in the carbohydrate content cannot be ruled out [8]. Earliar studies suggested that toxicant produced by pesticides application retarded the protein and Carbohydrate synthesis by inducing alteration in cytochrome oxidase activity, blocking alternative respiratory pathways [9].

It was observed that Tetraconazole and Copper oxychloride have shown the highest inhibitory effect on the growth and germination of both the *Cicer areitinum* and *Zea mays*. It was observed that all the concentrations used had significant effect on the germination and growth of seeds/seedling (radicle and plumule). It was also observed that these pesticides have showed decrease in the germination percentage and growth with the increase in concentration (i.e Blitox gave higher growth value at 0.25% concentration, followed by 0.5% and finally the least growth was observed with 1% concentration. The behavior of some pesticides shows that higher concentration required more time to degrade and there are reports to show that higher concentrations of pesticides have harmful effects on the various growth parameters of plants [10] [11].

In the present experiment with petridishes, it was observed that germination and growth of the gram (*Cicer arietinum*) and maize (*Zea mays*) seeds/seedlings showed inhibitory as well as growth promoting effect in various concentration of the different group of pesticides used. It was observed that at some concentrations, some pesticides have proved highly phytotoxic effect. Systemic pesticides may inhibit the growth characteristics and development of plant [12]. The effect of pesticides on germination of seeds and plant growth ultimately affect the plant health and productivity in the process. It also decreases the soil fertility status contributing to loss of.productivity of the exposed crop plants at large.

According to the study, it can be seen that the systemic fungicides viz., Carbendazim application gave best germination, growth and biomass stimulating effect on the treated seedlings of *Cicer arietinum* and *Zea mays.* It was also observed the use of some pesticides cause serious detrimental effect on the seed germination, growth as well as in biomass production, as observed with Copper oxychloride, Tetraconazole and Hexaconazole,

which showed the inhibitory effect on the germination, growth and biomass production both in *Cicer arietinum* and *Zea mays.* It can be seen that Captan fungicide also showed inhibitory effect as well as stimulatory effect in different concentrations used in the present study.

These findings suggest that a careful screening of pesticides should be carried out in the laboratory before their field applications. Further research on pesticides plant growth interactions at molecular level is needed to observe stress caused by the pesticide. Systemic pesticides may inhibit the growth characteristics of the plants. The systemic insecticides and the topical insecticide had no observable impact on the growth characteristics [18-20]. So, it was proved that the ingredients in some systemic pesticides may inhibit the growth and development of plants [13].

CONCLUSION

The data obtained indicates that germination percentage of seeds and biomass production were slightly affected with the differences in the two crops under investigation. The fungicide Bavistin (Carbendazim) at 10 ppm concentration was the best among the treatments of *Cicer arietinum* while in case of *Zea mays*, 1ppm concentration of Bavistin (Carbendazim) has shown better stimulating effect on the seed germination and plant growth (radicle and plumule) as compared to Control. Significant differences in the growth values of seeds between treated and control plants were observed.

REFERENCES

1. Satake, M., Y. Mido, H. Yasuhisa, S. Taguchi, M.S. Sethi and S.A. Igbal, 1997. Environmental Toxicology. Discovery Plublishing House., New Delhi, pp: 153-197.
2. Buss, M.D., A.W. Ratcliff, C.J. Shestak and R.F. Power, 2001. Glyphosphate Toxicity and the effect of long-term vegetation control on soil microbial communities. Soil Biol. and Biotechnol., 33: 1777-1789.
3. Pimentel, D. and A. Greiner, 1997. Environmental and Socio-economic costs of pesticide use. In: D. Pimentel, Ed., Techniqes for Reducing Pesticide Use: Economic and Environmental benefits, John Wiley and Sons, Chichester, pp: 51-78.
4. Ramadan, M.A., O.M. E1-Tayeb and M. Alexander, 1990. Inoculation for biodegradation. Appl. Environ. Microbiol., 56: 1392-1396.
5. Sartaj, A., Tiyagi, A. Shamim and M.F. Azam, 2004. Effect of some pesticides on plant growth, root nodulation and chlorophyll content of chickpea, Archives of Agronomy and Soil Sciences, 50(6): 529-533.
6. Saeidi, G. and A.A.M. Mirik, 2006. Fungicide seed treatment and seed color effects on seed vigour and emergence in flax. Int J. Agric. Biol., 8(6): 732-735.
7. Amar, L. and L. Reinhol, 1973. Loss of membrane transportability in leaf cell and release of protein as a result of osmotic shock. Plant Physiol., 51: 620-625.
8. Siddiqui, Z.S. and S. Ahmed, 2002. Effects of systemic fungicides on protein, carbohydrate, amino acids and phenolics contents of susceptible (Mexipak) and resistant (Poven) verities of *Triticum aestivum* L. Turk. J. Bot., 26: 127-130.
9. Siddiqui, Z.S. and S. Ahmed, 2000. Effect of systemic fungicide on nutritive composition of diseased and healthy plant of *Triticum aestivum* L. Pak. J. Biol. Sci., 3: 2148-2150.
10. Reyes, A.A., 1975. Phytotoxicity of benomyl to saffron. Phytopath., 65: 1-6.
11. Foster, H., Buchenauer and F. Grossman, 1980. Side effects of systemic fungicides triadimfon and triadimenol on barley plants. I. Influence on growth and yeild. Zeitschrift fulPflanz and Pflanzen., 87: 473-492.
12. Elloit, K. and Wensha, 2006. Impact of systemic Pesticides on Plant Growth California state scientific fare project No.51432, Abstract: 2.
13. Siddiqui, Z.S. and Ahmed, Soaliha, 2006. Combined Effects of Soybean Plants. Pak.J.Bot., 38(3): 721-733.
14. Ahmad, M. and M.S. Khan, 2011. Plant growth promoting fungicides-tolerant rhizobium improved growth and symbiotic characteristics of lentil (*Lens esculentus*) in fungicide applied soil. J Plant growth Regul., 23: 32-39.
15. Dutta, B.K., S. Debnath, S.K. Pradhan and R.M. Gurung, 1992. Role of systemic fungicides in the management of Blister blight in Darjeeling. *Proceedings of the 31st Tocklai Conference-Challenges of the Nineties, TRA* Jorhat, Assam (20-21st January 1992), pp: 153-162.
16. Tester, M., 1990. Plant Ion Channels: whole-cell and single channels studies. New Phytol., 114: 305-345.

17. Visitacion, R.S., J. De Jesus, G. Sia Su and E. Ragragio, 2011. Germination and Seedling growth responses of water Spinach (*Ipomoea aquatica*) and Spinach (*Spinacia oleraceae*) at varying lead concentrations. Journal of Applied technology in Environmental Sanitation, 1(2): 139-142.
18. Hossein Berenjeian Tabrizi, Ali Abbasi and Hajar Jahadian Sarvestani, 2013. Comparing the Static and Dynamic Balances and Their Relationship with the Anthropometrical Characteristics in the Athletes of Selected Sports, Middle-East Journal of Scientific Research, 15(2): 216-221.
19. Anatoliy Viktorovich Molodchik, 2013. Leadership Development: A Case of a Russian Business School, Middle-East Journal of Scientific Research, 15(2): 222-228.
20. Meruert Kylyshbaevna Bissenova and Ermek Talantuly Nurmaganbet, The Notion of Guilt and Problems of Legislative Regulations of its Forms: The Notion of Guilt in the Criminal Law of Kazakstan, Middle-East Journal of Scientific Research, 15(2): 229-236.