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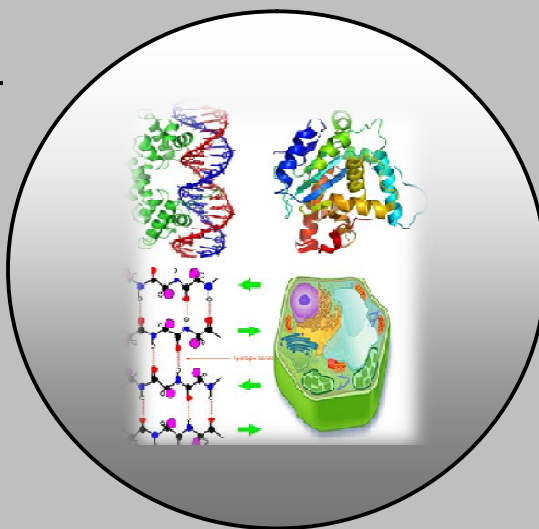
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RESEARCH PAPER

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Effect of Presence of Fungicide on Growth Parameters of Wheat (*Triticum aestivum* L.) Seedlings

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ABSTRACT

In modern agriculture practices, fungicides are most commonly used for protection of seeds from various fungal diseases. The use of fungicide whether beneficial or detrimental for growth of crop is an issue since long time. So the present study was aimed at evaluation of effect of commonly used fungicide Carbendazim on various growth parameters of wheat seedlings. The parameters studied were germination percentage, root length, shoot length, vigor index, fresh weight, dry weight and viability percentage. Five different concentrations of fungicide were used including recommended dose of fungicide. At all the studied concentrations there was increase in germination percentage, root length, shoot length, vigor index, fresh weight and viability percentage and decrease in dry weight. Maximum increase in germination percentage (25%), root length (82.98%) and shoot length (47.25%) occurred at 1500 mg/l concentration of fungicide. The vigor index reached its maximum increase (109.95%) at 2000 mg/l concentration of fungicide. In fresh weight and dry weight maximum increase (74.62%) and maximum decrease (-7.14%) occurred at 2500 mg/l concentration of fungicide respectively. Maximum increase in viability percentage (40%) was found at 500 mg/l concentration of fungicide.

It was concluded from the present study that there was increase in the water retention capacity of seedlings in presence of fungicide at recommended dose but dose higher than recommended could be proved harmful for the growth of seedlings.

Key words: Fungicide- Carbendazim, Wheat Seedlings, Viability Percentage, Vigour Index.

INTRODUCTION

Treatment of seeds with systemic fungicide is a conventional method used for the control of seed borne infection in intensive wheat production. Seed treatment with a proper formulation affects the initial development of plants which, in turn, will influence later stages of growth and development and, finally, yield levels (Dawson & Bateman 2000; Schoeny et al. 2001; Krzyżińska et al. 2004).

Wheat (*Triticum aestivum* L.) is the most important crop in the world and also in Madhya Pradesh, this crop is among the 'major three' cereal crops that provided 20 percent of the energy in human food (Ahmadi et al., 2004; Shewry, 2009).

Fungicide carbendazim is an active metabolite of benomyl and have properties similar to benomyl. Previous research revealed that the inhibitory effect of carbendazim is due to inhibition of polymerization of tubulin into microtubules. This fungicide binds on β -tubulin in microtubules inhibiting their proliferation and suppressing their dynamic instability. (Koo et al., 2009)

There is very little information available with regard to the effect of fungicide on pulses and cereals generally and wheat particularly. Therefore the present study was undertaken with a view to understand the effect of commonly used fungicide Carbendazim on the growth parameters of wheat seedlings.

MATERIAL AND METHODS

The fungicide Carbendazim was used for the present study. The five different concentrations of fungicide viz 500, 1000, 1500, 2000 and 2500 mg/l were used in the study. Healthy wheat seeds were surface sterilized with 0.1% HgCl_2 for 5 min and then were washed thoroughly with distill water. The seeds were then allowed to germinate for 24 hrs. Germinated seeds were then transferred in petriplates lined with Whatmann filter paper no. 1. At the start of the experiment 3 ml of respective concentration was added to moisten filter paper in each petriplates and every day, 2 ml of respective concentration was added for consecutive 6 days. Three sets in each concentration were maintained along with the control for comparison. On the seventh day, various growth parameters were evaluated as follows:

1) Germination percentage: Germination percentage was estimated by the below formula given by Rehman et al., (1998):

$$\text{Germination \%} = \frac{\text{no. of seeds germinated}}{\text{total no. of seeds}} \times 100$$

2) Root and shoot length: Root and shoot length of seedlings were recorded using the standard centimeter scale (Kabir, 2008).

3) Vigour index: Vigour index was calculated using following formula suggested by Abdul Baki and Anderson (1973):

Vigour index = germination % \times (root length + shoot length)*

(* indicate that root length and shoot length should be in cm)

4) Fresh and dry weight: Four seeds of each treatment were weighed in order to determine the fresh weight and then dried in oven at 80 °C for 24 hrs to obtain dry weight (Kabir, 2008). Fresh weight and dry weight were recorded in gms.

5) Viability percentage: It was determined using method given by Lakon (1942) in which colorless triphenyl tetrazolium dye was used which turns red when is reduced by respiring embryo i.e. indication of germination.

RESULTS

Table no.1 is showing effect of different concentration of fungicide on germination %, root length, shoot length and vigor index of wheat seedlings, Table no-2 is showing effect of fungicide on fresh weight, dry weight and viability % of wheat seedlings and table no. 3 is showing percent increase in germination percentage, root length, shoot length, vigor index, fresh weight and viability percentage and percent decrease in dry weight of wheat seedlings.

Germination percentage in control was 74.66 ± 10.06 and at 500, 1000, 1500, 2000, 2500 mg/l concentration of fungicide was 84.0 ± 12 , 84.12 ± 12 , 93.33 ± 4.6 , 90.66 ± 6.1 and 84.33 ± 0.5 respectively. Highest increase in germination percentage was observed at 1500 mg/l (25.0%) concentration of fungicide.

Root length in untreated wheat seedling was observed to be 6.23 ± 2.3 cm. Root length of wheat seedlings at 500, 1000, 1500, 2000 and 2500 mg/l was found to be 10.0 ± 2.32 , 10.3 ± 2.3 , 11.4 ± 0.28 , 11.2 ± 0.70 and 10.6 ± 0.58 cm respectively. Maximum root length was found at 1500 mg/l (82.98%) concentration of fungicide.

Shoot length in control seedlings was 6.2 ± 1.10 cm and at 500, 1000, 1500, 2000 and 2500 mg/l concentration of fungicide was found to be 7.9 ± 1.31 , 8.83 ± 0.49 , 9.13 ± 0.90 , 8.63 ± 0.90 and 8.53 ± 0.45 cm respectively. The highest increase i.e. 47.25% was found at 1500 mg/l concentration of fungicide.

Vigor index of wheat seedling in control was 860.2 ± 130 . Vigor index of wheat seedlings at 500, 1000, 1500, 2000 and 2500 mg/l was found to be 1521.6 ± 444.7 , 1780 ± 97.3 , 1734 ± 298.3 , 1806.4 ± 240.7 and 1616.2 ± 23.1 respectively. Thus among the entire studied concentration highest % increase in vigor index i.e. 109.95% was observed at 2000 mg/l concentration of fungicide.

Fresh weight of wheat seedling in control was 0.67 ± 0.11 gms. Fresh weight of wheat seedlings at 500, 1000, 1500, 2000 and 2500 mg/l was found to be 0.93 ± 0.12 , 1.03 ± 0.06 , 1.04 ± 0.06 , 1.05 ± 0.08 and 1.17 ± 0.01 gms respectively. The highest % increase in fresh weight was 74.62% which corresponds to 2500 mg/l of fungicide.

In control dry weight was observed to be 0.14 ± 0.02 gms. Dry weight at 500, 1000, 1500, 2000 and 2500 mg/l concentration of fungicide was found to be 0.10 ± 0.005 , 0.11 ± 0.005 , 0.12 ± 0.01 , 0.12 ± 0.02 and 0.13 ± 0.005 gms respectively. The highest decrease i.e. - 28.57% was found at 500 mg/l concentration of fungicide.

In control viability % was observed to be 66.66 ± 5.7 . Viability % of wheat seedlings at 500, 1000, 1500, 2000 and 2500 mg/l was found to be 93.33 ± 5.7 , 90.0 ± 10 , 86.66 ± 5.7 , 76.66 ± 5.7 and 76.66 ± 5.7 respectively. The highest % increase in viability % was 40% which corresponds to 500 mg/l of fungicide.

DISCUSSION

The fungicide carbendazim highly influenced all the studied growth parameters of wheat seedlings. Germination percentage of fungicide treated seed gets increased with increase in concentration of fungicide. Various other studies also found that seed germination was stimulated by thiamethoxam in soybean, pea and corn (Horii *et al.*, 2007; Cataneo *et al.*, 2010). The results are contradictory to study of Marini *et al.*, (2011) who reported that fungicide produces negative interference in germination of seeds.

The present study results demonstrated that root length was increased with increasing concentration of fungicide. Results were in agreement with the work done by S.K. Sarkar and Saxena (2005) and Bensoltane *et al.*, (2006).

The shoot length was increased with increase in concentration of fungicide. The present study results were contrary to Windham & Windham (2004) who have reported that systemic fungicides which are based on sterol biosynthesis inhibitor are closely related to plant growth regulators the use of which at higher than labeled rates shorten the internodes which may lead to slow shoot growth.

In the present study vigor index of fungicide treated seedlings get increased with increase in concentration of fungicide. The increase in vigor index was significant at almost all the concentration of fungicide as compared to control. These findings agreed with findings of Doyle *et al.*, (2001) who proved that seedlings treated with thiamethoxam had a particular advantage of improved seedling vigor. Csinos (2004) revealed that mefenoxam improved vigor index of tobacco.

In the present study, results of wheat seedlings treated with fungicide indicate increase in fresh weight with increasing concentration of fungicide. These results were in parallel with the findings of Avinash and Hoshmani (2012) that fresh weight of leaves of sorghum seeds treated with carbendazim increase with increase in concentration of fungicide. The results were also similar to the effect of tricyclazole on Maize seeds (Avinash, 2012).

Table 1. Showing effect of fungicide on germination %, root length, shoot length and vigor index of wheat seedlings.

S.No.	Conc. of fungicide in mg/l	Germination %	Root length in cm	Shoot length in cm	Vigor index
1.	0	74.66±10.06	6.23±2.30	6.2±1.10	860.2±130.1
2.	500	84.0±12 ^{ns}	10.0±2.32*	7.9±1.31*	1521.6±444.7*
3.	1000	84.12±12 ^{ns}	10.3±2.30*	8.8±0.49**	1780±97.3**
4.	1500	93.33±4.6*	11.4±0.28**	9.1±0.90**	1734±298.3**
5.	2000	90.66±6.1*	11.2±0.70**	8.6±0.90**	1806.4±240.7**
6.	2500	84.33±0.5*	10.6±0.58**	8.5±0.45**	1616.2±23.1**

*= Values are Significant (p<0.05), **= Values are very significant (p <0.01) and ns= not significant(p>0.05).

The dry weight gets decreased under influence of fungicide which may be due to increase in water retention capacity of seedlings. The results were not in accordance with the work of Minamor (2013) who reported no difference in dry weight of fungicide treated and untreated cocoa seedlings. According to the present study viability % was increased with increase in concentration of fungicide. The results were not in accordance with the work of Hames *et al.*, (2012) who showed seed treatments with fungicide did not affect seed viability. While studying all the parameters, it was seen that proportionate increase occurred in all the parameters up to 2000mg/l of Carbendazim fungicide used. The growth promoting ability of Carbendazim may be due to its structure which has similarity with cytokinin hormone (Thomas, 1973).

Table 2. Showing effect of fungicide on fresh weight, dry weight and viability % of wheat seedlings.

S.No.	Conc. of fungicide in mg/l	Fresh weight in gms	Dry weight in gms	Viability %
1.	0	0.67±0.11	0.14±0.02	66.66±5.7
2.	500	0.93±0.12**	0.10±0.005*	93.33±5.7**
3.	1000	1.03±0.06**	0.11±0.005 ^{ns}	90.0±10**
4.	1500	1.04±0.06**	0.12±0.01 ^{ns}	86.66±5.7**
5.	2000	1.05±0.08**	0.12±0.02 ^{ns}	76.66±5.7*
6.	2500	1.17±0.01**	0.13±0.005 ^{ns}	76.66±5.7*

*= Values are Significant (p<0.05), **= Values are very significant (p <0.01) and ns= not significant(p>0.05).

Table3. Showing % increase/decrease in studied growth parameters of wheat seedlings under influence of fungicide.

S.No.	Conc. of fungicide in mg/l	Germination %	Root length	Shoot length	Vigour index	Fresh weight	Dry weight	Viability %
1.	0	-	-	-	-	-	-	-
2.	500	12.51%	60.51%	27.41%	76.81%	38.8%	-28.57%	40.0%
3.	1000	12.67%	65.32%	42.41%	106.92%	53.73%	-21.42%	35.01%
4.	1500	25.0%	82.98%	47.25%	101.58%	55.22%	-14.28%	30.0%
5.	2000	21.43%	79.77%	39.19%	109.95%	56.71%	-14.28%	15.0%
6.	2500	12.95%	70.14%	37.58%	87.88%	74.62%	-7.14%	15.0%

CONCLUSION

From the present study it was concluded that the recommended concentration of Carbendazim favors growth of seedlings but concentration higher than recommended can be unfavorable for proper growth of seedlings. So it was suggested from the present study that farmers should use 2000 mg/l of fungicide carbendazim on wheat.

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REFERENCES

- Abdul-Baki, A. A. and Anderson, J.D. 1973. Vigor determination of soybean seeds by multiple criteria. *Crop Sci.* 13: 630-633.
- Ahmadi A., Yazdi-Samadi, B. and Zargar-Nataj, J. 2004. The effects of low temperature on seed germination and seedling physiological traits in three winter wheat cultivars. *Agr Sci Nat Res* 11:117-126.
- Avinash, V.S. and Hosmani, S.P. 2012. Studies on the Germination and Metabolism of Sorghum seeds treated with Carbendazim. *Global Research Analysis.* 1 (5):3-4.
- Avinash, V.S. 2012. Effect of Tricyclazole on Germination and Metabolism of Zea mays. *Nat.Env.Poll.Tech.* 11(2); 335-338.
- Bensoltan, S., Youbi, M., Djebar, H. and Djebar, M.R. 2006. Effects of two systemic fungicides: Artea (Propiconazole+cyproconazole) and Punch (Flusilazole) on the physiology and the respiratory metabolism of durum wheat (*Triticum durum* L.). *Commun Agric Appl Biol Sci.* 71(3 Pt B):1041-8.

- Cataneo, A.C., Ferreira, L.C., Carvalho, J.C., Andréo-Souza, Y., Corniani, N., Mischan, M.M., Nunes, J.C. 2010. Improved germination of soybean seed treated with thiamethoxam under drought conditions. *Seed Sci. Technol.* 38:248-251.
- Csinos, A.S. 2004 Efficacy of fungicides on tobacco blankshank. *Phytopathology*. 94:9.
- Dawson, W. and Bateman, G. 2000. Sensitivity of fungi from cereal roots to fluquinconazole and their suppressiveness towards take-all on plants with or without fluquinconazole seed treatment in a controlled environment. *Plant Pathology*, 49: 477–486.
- Doyle, P., Stypa M., Schneidersmann F. and Ramachandran R. 2001. New generation seed treatment products for canola (***Brassica napus***, ***B. campestris***) and mustard (***Sinapsis alba***, ***Brassica juncea***). British crop protection council Symposium proceedings. 76:173-180.
- Hames, A.W., Trevathan, L.E. and Tomaso-Peterson, M. 2012. Germination, Shoot Growth, Root Growth and Seedborne Fungi of Fungicide Treated Wheat Seed in Mississippi. *Journal of the Mississippi Academy of Sciences*. 57(4): 235-239.
- Horii A., McCue, P. and Shetty K. 2007. Enhancement of seed vigour following insecticide and phenolic elicitor treatment. *Bioresour. Technol.* 98:623-632.
- Kabir, M., Iqbal, M.Z., Shafiq, M. and Farooqi, Z.R. 2008. Reduction in germination and seedling growth of ***Thespesia populnea*** caused by lead and cadmium treatments. *Pak. J. Bot.*, 40(6): 2419-2426.
- Koo, B.S., Park, H. and Kalme S. 2009. “ α - and β -tubulin from *Phytophthora capsici* KACC 40483: molecular cloning, biochemical characterization, and antimicrotubule screening,” *Applied Microbiology and Biotechnology*. 82,(3) 513–524.
- Krzyzinska, B., Mączynska, A. and Sikora, H. 2004. Zwalczanie chor• grzybowych liści za pomocą zapraw Nasiennych w uprawie jęczmienia jarego. Progress in Plant Protection/Postepy w Ochronie Roslin, 44: 877–880.
- Lakon, G. 1942. Topographischer Nachweis der Keimfähigkeit der Getreidefrüchte durch Tetrazolium-Verfahren [The ‘vigour’ of seeds and its determination by the topographical terazolium method]. *Saatgutwirtschaft* 2:37–41.
- Marini, N., Tunes, L.M., Silva J.I., De Moraes, D.M., Olivo, F. and Cantos, A.A. 2011. Carboxim Tiram fungicide effect in wheat seeds physiological quality (***Triticum aestivum*** L.). *Revista Brasileira de Ciências Agrárias* . 6 (1): 17-22.
- Minamor, A.A. 2013. Effect of Two Fungicides (Caocobre and Ridomil) on Germination and Radicle Elongation of Cocoa (***Theobroma Cacao*** L) Seedlings. *Int. J. Pure Appl. Sci. Technol.*, 15(1) (2013), pp. 79-86
- Rehman, S., Harris, P.J.C. and Bourne, W.F. 1998). Effect of pre-sowing treatment with calcium salts, *Acacia* seeds. *J. Plant Nutrition*. 21: 277-285.

- Sarkar, S.K. and Saxena, S.C. 2005. Field efficacy of seed dressing fungicides on emergence, survival and seedling vigour of sunhemp (*Crotalaria juncea* L.). *Seed Res.*, 33(1): 100-102.
- Schoeny, A., Jeuffroy, M. and Lucas P. 2001. Influence of take-all epidemics on winter wheat yield formation and yield loss. *Phytopathology*, 91: 694–701.
- Shewry, P.R. 2009. *Wheat. J of Exp Bot* 60:1537-1553.
- Thomas, T. H., 1973, Growth regulatory effect of three benzimidazole fungicides on the germination of celery (*Apium graveolens*) seeds, *Ann. App/Biol.*, 76.233-238.
- Windham, A.S. and Windham, M.T. 2004. Chemical control of plant diseases. In: *Plant Pathology*. Concepts and Lab Exercises. CRC Pub.USA.

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