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# Effect of carbendazim on seed germination and biochemical changes of rice (*Oryza sativa*) Cultivar

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**ABSTRACT**

*Rice cultivar M1001 was treated with different concentrations of Carbendazim. The seeds were allowed to germinate for 14days and then analysed for morphological and biochemical parameters. The biochemical parameters like chlorophyll a, reducing sugar, free amino acids were significantly reduced where as chlorophyll b, total chlorophyll and total carbohydrate content increased with the increase concentration of carbendazim. The study also revealed that the morphological parameters like percentage seed germination, seedling length, and vigour index reduced at higher concentration of carbendazim while electrical conductivity increased with increased concentration of carbendazim*

**KEYWORDS : Carbendazim, seed germination, biochemical parameters**

## INTRODUCTION

Rice is the most important food crop of the world. India is the second largest producer after china. Annual rice production is 104.80 million metric tons with an area of 43.00 million hectares (USSD-2015). The productivity has declined as rice crop is encountered by Fungi, Bacteria, Viruses, Nematodes and Mycoplasmas. The important diseases of rice that often caused economic losses are rice blast, bacterial blight, sheath blight, sheath rot and tungro disease. Agricultural research till now is primarily concerned with increased crop productivity by application of pesticides, use of improved resistance varieties, biological and chemical control. Fungicides form a most essential part of crop production technology and have achieved varying degree of success in managing rice diseases (Ling 1980). Carbendazim is systemic benzimidazole fungicide that plays a significant role in control of plant disease. It is used for both pre and post harvest treatment ( Elzbieta *et al*.,2006). Despite of its advantage yet there are several reports showing phytotoxic effects on plants. Hence in order to know the residual effect of carbendazim on growth and biochemical constituents of rice the present work was undertaken.

## MATERIALS AND METHODS

Paddy seed sample of cultivar M1001 was procured from VC farm, University of Agriculture science, Mandya, Karnataka. Seeds were surface sterilized with 0.1% mercuric chloride for 10 minutes and repeatedly washed with distilled water for 4-5 times to remove the excess chloride. Seeds of uniform size were selected and soaked for 24 hours in distilled water (control) and with different concentrations (mg/g) of carbendazim ie, 1mg, 3mg, 6mg, 9mg, and 12mg/g of the seeds. The germination studies were carried out according to the between paper method as per International Seed Testing Association (1993).

Three sets of each concentration were maintained along with the control for comparison. The seeds were allowed to germinate for 14days and then analysed for morphological and biochemical parameters.

Percentage seed germination was recorded in each experimental set and calculation made according to ISTA (1993). Seedling Vigour Index was calculated by modified formula of Abdul-Baki and Anderson (1973). The electrical conductivity was determined by measuring the leakage of electrolytes from seed coat (Hendricks and Taylorson 1976). Chlorophyll content was estimated by Arnon method (Arnon 1949). Reducing sugar was estimated by Dinitro salicylic acid method (Miller 1972). Total carbohydrate and starch were estimated by Anthrone method (Hedge 1962). Total phenol was estimated by Folin-Ciocalteau method (Malick and Singh 1980). Total free amino acids were extracted and determined following the method of Sugano *et al.,* (1975).

**Statistical analysis:**

The data obtained were subjected to analysis of variance using SPSS 20.0 version. The data were expressed as the mean analyzed by one way analysis of variance and Scheffe method was followed for the test of significance.

**Result and discussion:**

The results obtained in relation to morphological and biochemical parameters were presented in Table-1

**Effect on Seed Germination and Vigour index:**

It was observed that among fungicide treated samples, the seed treated with 6mg, 3mg, and 1mg showed 93% and 92% germination with vigour indices 1415.9, 1432.3 and 1202.5 respectively. The maximum decline of 89% and 73% of germination was recorded in 12 and 9mg treated seeds compared to control. Similar observations were made by Sathees Kannan *et al*., (2014) who reported that the seedling growth and seed germination percentage in *Oryza sativa* seedlings was completely reduced at higher concentrations of fungicide treatment (Sivic).

**Effect on Seedling length:**

**Root length:**

The root length decreased significantly in all concentrations as compared to control (untreated seedling). These observations were in accordance with the findings of Mamta Hirve (2013) who reported that the root length of all varieties of *Vigna radiata* seedlings decreased with increased concentrations of Cadmium.

**Shoot length:**

Shoot lengths were also found to be significantly decreased in all concentrations of fungicides compared to control except at 6mg concentration which showed increased shoot length. This may be because of threshold limit of fungicide that can be tolerated by the plant. Mishir *et al*., (2014) showed that all morphological traits like shoot length, root length and root/shoot ratio of *Vigna radiata* seedlings decrease with increased concentration of profenofos 50% EC.

**Effect on Electrical conductivity:**

Electrical conductivity was found to be increased with increased concentrations of fungicide and maximum conductance was observed at 12 mg concentration.

**Chlorophyll a, b, and total chlorophyll:**

chlorophyll a, chlorophyll b, and total chlorophyll content were found to be decreased at all concentrations of carbendazim as compared to control. The chlorophyll-content was found to be almost similar in 6 and 9mg concentrations. The maximum decrease was observed at 1 and 3 mg concentrations.

chlorophyll- b and Total chlorophyll content was less at 1 mg concentration. However in treated seeds both chlorophyll b and total chloro-

phyll contents were high at 3, 6, 9 and 12 mg concentrations. Increase in chlorophyll content when treated with Topsin fungicide has also been reported in *Hibiscus esculentus* by Soaliha Ahmed (1995).

**Starch content:**
In the present study the starch content was found to be decreased in treated seeds over control. However the starch content was found to be maximum at 12 mg concentration and minimum at 3mg concentration. Avinash and Shankar P Hosmani (2012) have reported a positive increase in 0.3 %, 0.2% and 0.05% and the starch content decreased at 0.1% carbendazim in *Sorghum bicolor.*

**Reducing sugar:**
Reducing sugar content decreased with increased concentration of fungicide. Jagatheeswari and Ranganathan (2012) noticed considerable decrease in reducing sugar in germinated green gram treated with mercuric chloride and also Rajashekar *et al.,* (2012) reported decrease in the amount of reducing sugar in both root -shoot axis of maize treated with different concentrations of Pendimethalin.

**Total carbohydrate:**
Total carbohydrate increased with increased concentration of carbendazim. Thus it has stimulatory effect on total carbohydrate as compared to control. Kengar *et al.,* (2014) reported similar results in Spinach treated with different concentrations of Hexaconazole.

**Free amino acid:**
As compared to control the free amino acids was found to be decreased effectively with the increased concentration of fungicide. However, the maximum amount of free amino acids was recorded in 1 mg concentration and the minimum in 3mg/g. Accumulation of amino acids might be the consequence of protein hydrolysis. Similar results were reported by Manzoor *et al*., (2014) in Brinjal treated with varied concentrations of Carbofuran.

**CONCLUSION:**
The datas obtained from the present study indicates that percentage germination, vigour Index, both biochemical and morphological parameters were affected at higher concentrations of fungicide. The phytotoxicity or residual effect can be minimized only if the fungicide is used within the threshold limit or recommended dosage.

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**Table.1. Effect of carbendazim on morphological and biochemical parameters of rice cultivar M 1001**

| Parameters | Control | Different concentration of Carbendazim (mg/g) | | | | | F value |
|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 6 | 9 | 12 | |
| Germination % | 94.00$^{a}$ | 92.00$^{ab}$ | 92.00$^{ab}$ | 93.00$^{a}$ | 73.00$^{c}$ | 89.30$^{b}$ | 154.65 |
| Vigour index | 1475.84$^{a}$ | 1432.32$^{a}$ | 1202.53$^{b}$ | 1415.96$^{a}$ | 938.66$^{c}$ | 1009.03$^{bc}$ | 44.53 |
| Root length (cm) | 10.40$^{a}$ | 10.20$^{b}$ | 8.55$^{e}$ | 9.44$^{d}$ | 8.46$^{f}$ | 9.65$^{c}$ | 44578.9 |
| Shoot length (cm) | 5.44$^{b}$ | 5.11b$^{c}$ | 5.02$^{c}$ | 6.42$^{a}$ | 4.16$^{d}$ | 4.11$^{d}$ | 136.39 |
| Conductance (mS/cm) | 349.66$^{b}$ | 352.66$^{b}$ | 362.33$^{b}$ | 367.33$^{ab}$ | 368.33$^{ab}$ | 416.00$^{a}$ | 8.04 |
| Chlorophyll a (mg/g) | 0.336$^{a}$ | 0.101$^{d}$ | 0.134$^{cd}$ | 0.197$^{bc}$ | 0.222$^{bc}$ | 0.304$^{ab}$ | 22.2 |
| Chlorophyll b (mg/g) | 0.414$^{a}$ | 0.147$^{b}$ | 0.226$^{b}$ | 0.364$^{a}$ | 0.347$^{a}$ | 0.413$^{a}$ | 25.94 |
| Total Chlorophyll (mg/g) | 0.749$^{a}$ | 0.256$^{c}$ | 0.367$^{c}$ | 0.563$^{b}$ | 0.534$^{b}$ | 0.730$^{a}$ | 84.7 |
| Reducing sugar (mg/g) | 3.302$^{a}$ | 2.946$^{b}$ | 2.541$^{c}$ | 2.012$^{d}$ | 1.816$^{e}$ | 1.542$^{f}$ | 63643.09 |
| Total carbohydrates (mg/g) | 310.00$^{f}$ | 391.00$^{e}$ | 451.33$^{d}$ | 472.00$^{c}$ | 492.333$^{b}$ | 512.33$^{a}$ | 4445.87 |
| Starch (mg/g) | 363.33$^{a}$ | 246.86$^{c}$ | 189.10e | 237.43$^{c}$ | 225.10$^{d}$ | 351.06$^{b}$ | 1367.194 |
| Amino acids (mg/g) | 1.430$^{a}$ | 1.410$^{a}$ | 1.123$^{d}$ | 1.243$^{c}$ | 1.230$^{c}$ | 1.310$^{b}$ | 524.171 |

Means followed by the same letter within a row are not significantly different as indicated by Scheffe ($P \leq 0.05$).

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