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EFFECT OF SYSTEMIC FUNGICIDE BENLATE (BENOMYL) ON SEEDLING GERMINATION AND GROWTH IN *ALLIUM CEPA* L.

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ABSTRACT

The seeds of *Allium cepa* L.Var.N-53 were selected and used for following research. The healthy, untreated and uniform seeds were treated with different concentration of benlate (0.02%, 0.04%, 0.06% and 0.08%) for 3, 6, 9, 12 hours treatment periods. Germination parameters like seed germination percentage, seedling height and root length were studied. All three parameter revealed gradual decrease from lower doses to higher doses in given treatments of fungicides benlate.

KEYWORDS: **Fungicide, *Allium cepa*, Seed Germination, Seedling Height, Root Length.**

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INTRODUCTION

The use of systemic chemicals against harmful organisms of crop plants is an accepted application at the present time. Nowadays many modern pesticides are in use all over the world; among them, systemic fungicides are extensively used in agriculture. Benlate are systemic fungicides used for the control of diseases such as smut, grey mold, leaf spot, brown patch, downy mildew, powdery mildew, and rust in wheat[1]. In benomyl the active ingredient is benlate WP and benlate DF (Du Pont) is especially effective because it penetrates plants better than carbendazim (MBC: methyl 2-benzimidazolecarbamate), its fungitoxic breakdown product[2]. Despite its enormous application, priority should be given to the possible side effects of these chemicals on non-targeted host (plant). There are many reports where the application of benlate produced chlorosis and irregular depression at the central and the marginal portion of saffron leaves[3]. Triarimol inhibits the seedling growth of pea[4] now there are many reports about side effect of benomyl on different plants system. Carbendazim delays senescence in wheat (*Triticum aestivum* L.)[5]. Benomyl show cytokinin-like activity in soyabean (*Glycine max* L.) callus, radish (*Raphanus sativus* L.) cotyledons[6]. Benomyl was also phytotoxic. Benomyl reduced the growth of cucumber (*Cucumis sativus* L.)[7]. American elm (*Ulmus americana* L.)[8]. Due to its cytokinin like structure benomyl was found sometimes to promote the growth of the treated plants[9].Which could be attributed to some positive alterations in plant metabolism[10]. Due to these two beneficial characteristiscs, benomyl deserves to be intensively studied. Thus the aim of the present work was to obtain additional information concerning its effects on some seedling germination and growth of *Allium cepa* L.

MATERIALS AND METHODS

Healthy and dry seeds of untreated *Allium cepa* L var. N-53 were obtained from National Horticultural Research and Development Foundation (NHRDF) Chittagong, Nasik. Seeds (1,500) were pre-soaked in tap water for 6 hours and then treated with four different concentrations (0.02%, 0.04%, 0.06%, 0.08%) of benlate fungicide for 3, 6, 9 and 12 hours. The pretreatment soaking, treatment and post-treatment germination was carried out at REMI growth chamber conditions of temperature 28+ 2^{O} C, photoperiod of 16 hours having 45 *m*mole m^{-2} S^{-1} illumination provided by cool white fluorescent tubes. The temperatures of the chamber were maintained according to International Seed Testing Association (ISTA 2008)[11] standard, throughout the germination period. Three replicates of each concentration were performed twice. The germination percentage, seedling height and root length (longest root) in cms was recorded on the 7^{th} day. Germination percentage calculates by Rehman[12]. Root and shoot length of seedlings were recorded using the standard centimeter scale Kabir[13]. The percentage of inhibition was calculated using formula described by Sundra and Pote[14].

RESULTS

In seed germination concentration of 0.02%, when used for 3 and 6 hours durations, appeared to be less effective dose and hence showing higher percentage of germination (75% each). As against this, 9 and 12 hours durations of treatments with the same dose it was more inhibitory (68 and 52%). Similar situation appeared in connection with 0.04% concentration where treatment at 3 and 6 hours duration was less effective (84 and 76% germination). In the case of 0.06% concentration, with the increase in duration it was from 68 to 51%. This reduction was from 57-48% in the case of 0.08% concentration. Thus, 0.08% concentration dose was seen to be more effective than 0.06% dose. Benlate had moderate action at 0.02% concentration. At 0.04% concentration it was the least effective for 3 and 6 hours duration and moderate at 9 and 12 hours duration. With the exception of 9 hours at 0.06% and of 12 hours at 0.08% concentration, it was a moderately effective fungicide. It was only the pesticide which showed inducing effect on root length; at 3 hours treatment at 0.02% concentration having 7.67 cms root length in relation to the control, 7.51 cms. The root length 7.43 cms on 6 hours treatment was almost equal to that of control, indicating negligible inhibition i, e 1.07%. From 9 hours onwards, the activity of benlate seemed to produce some good effects. It was for the first time, that at 9 hours treatments, 19.31% inhibition was noted with 6.06 cms root length. The root length was further reduced to 5.70 cms (24.11% inhibition) at 12 hours (Table I). At 0.04% concentration there was duration dependent reduction from 3 to 12 hours. Increase in duration from 9 to 12 hours did not show any significant retarding effect on root length. This was evident from a meager difference of 0.17 cms between the two values. The same trend was maintained at 0.06% treatment i.e; the decrease from 4.43 to 2.72 cms root lengths with the increase in duration from 3 to 12 hours. The treatment at 0.06% concentration revealed two noteworthy points, - 1) the shortest root length 2.72 cms recorded a 12 hours treatment 2) The values of root length at 3 hours (4.43 cms) and 12 hours (2.72 cms) indicated exactly 62.79% inhibition with an increase from 3 to 12 hours durations (Table I). The values of root lengths for 3 to 12 hours treatment were 3.09, 2.86 cms 3.27 and 2.75 cms respectively, and indicated that 12 hours was the most effective duration at 0.08% concentration. Benlate revealed the least effective for 3 and 12 hours duration and moderate at 6 and 9 hours treatment at 0.02% concentration. From 0.04 to 0.08% concentrations, it was the least effective fungicide for all the durations of treatment. At 0.06% with 3 hours treatment, 4.43 cms root length revealed 48.40% inhibition than that of control, 7.51 cms. The root length recorded at 0.02%, with 6 hours treatment was 7.43 cms in comparison with 4.02 at 0.06% , 6 hours duration revealing 46.48% inhibition (Table-I). It exhibited dose dependant inhibition

of length over 0.02 to 0.08% concentrations at all four duration i.e. at 3 hours, 7.67-3.09 cms, 6 hours, 7.43-2.86 cms 9 hours, 6.06-3.27 cms and 12 hours, 5.70-2.75 cms. This revealed the significance of all 4 concentrations in benlate treatment in above respect. A duration dependant decrease in root length i.e. from 7.67 to 5.70 cms at 0.02% from 5.13 to 3.43 cms at 0.04% and from 4.43 to 2.72 cms at 0.06% was noticed with increasing duration from 3 to 12 hours. At 0.02% concentration with 3 hours duration there was a stimulating effect of 1.23 cms over that of the average seedling height in control (17.56 cms). At the same time there was 7.43% inducing effect seen in the growth of the treated seedlings. The statement is based on the assumption that the control seedlings growth was 100 %. At 6 hours there was also an inducing effect but it was marginal (0.14 cms) i,e; it showed an inducing effect of only 0.84% growth in the treated seedlings as compared to that of control (Table I). It was noted that instead of having an inducing effect as recorded earlier, 9 and 12 hours treatments were inhibitory to the seedlings. The height which was reduced to 15.66 cms with 10.83% growth inhibition at 9 hours had gone down to 13.77 cms with 21.59% inhibition at 12 hours duration. At 0.04%, the trend in the reduction in the seedling height was 12.42 > 8.10> 7.12> 7.08 cms with the increasing duration from 3 hours to 12 hours. Identical values of height at 9 and 12 hours showed that there was no impact of rise in duration by three hours. At 0.06% concentration also, there was a dose related reduction in the seedling height from 8.96 to 4.62 cms with the increase in duration from 3 to 12 hours. One important feature of 0.06% concentration for 12 hours treatment was that it exhibited the most retarding effect on the seedling height among all the benlate treatments. Very small differences in the values of the seedling heights (0.11, 0.54, 0.15 cms) showed that there was very little impact of 3 and 6 hours, 6 and 9 hours and 9 and 12 hours respectively ,on the inhibiting power of 0.08 % treatment. Benlate exhibited the least effectiveness for 9 and 12 hours treatment at 0.02% concentration. At 0.04%, it was a moderate fungicide except for the duration of 3 hours. At 0.06 and 0.08% concentration, it was a moderate fungicide in total. It was thrice the least effective at 0.04% to 0.08% concentration. At 0.06% 3 hours the seedling height was 8.96 cms with 48.98% inhibition in relation to 17.56 cms at control. The height at 0.02/9 hours treatment i.e. 15.66 cms was reduced to 7.89 cms with 55.07 % inhibition at 0.06% concentration with 6 hours treatment. At all four concentration there was a duration dependant decrease in height from 3 to 12 hours at 0.02% (from 18.79 to 13.77 cms); 0.04% (from 12.42 to 7.08 cms) 0.06% (from 8.96 to 4.62 cms); and 0.08% (from 6.39 to 5.59 cms). This indicated importance of all four durations from 3 to12 hours in Benlate treatment in this regard (Table I).

DISCUSSION

Seed germination is an important parameter used to measure the response of plant to mutagenic treatments[15].The percentage of germination may reflect the reaction rate of plant seeds to their living environment[16]. In the present work, after 6 hour treatment with 0.08% concentration of fungicide benlate, the germination was lowered down to 52% from 87% in control. According to Gordon[17], the inhibition in seed germination might be due to inhibition of auxin synthesis in mutagen treated seeds. Reduction in germination due to mutagenic treatment has been explained due to delay or inhibition in physiological and biological processes necessary for seed germination which include enzyme activity, hormonal imbalance and inhibition of mitotic activity[18,19]. Seedling height is widely used as an index for determining the biological effects of various mutagens[20]. After 6 hour treatment, 7.09 cms and 5.27 cms height were recorded at 0.04% and 0.08% in comparison to control, 17.56 cms. The study by Heisy[21] proposed that exposure of plants to fungicide create chemical stress facilitating the production of compounds that are potential inhibitor of germination and seedling growth. Baig[22] investigated the effect of glyphosate applications on seedling growth of *Pisum sativum*. Root length is another important parameter used to test mutagen sensitivity. Ratsch[23] concluded that inhibition of root elongation was a valid and sensitive indicator of environmental toxicity. Benlate inhibit of root growth due to the breakdown product n-butylamine, which can reduce root growth of *Hyoscyamus alba* and *Datura stramonium*[24].

Figure 1
Effect of fungicide benlate on seed germination (%) in Allium cepa L. in M_1 generation

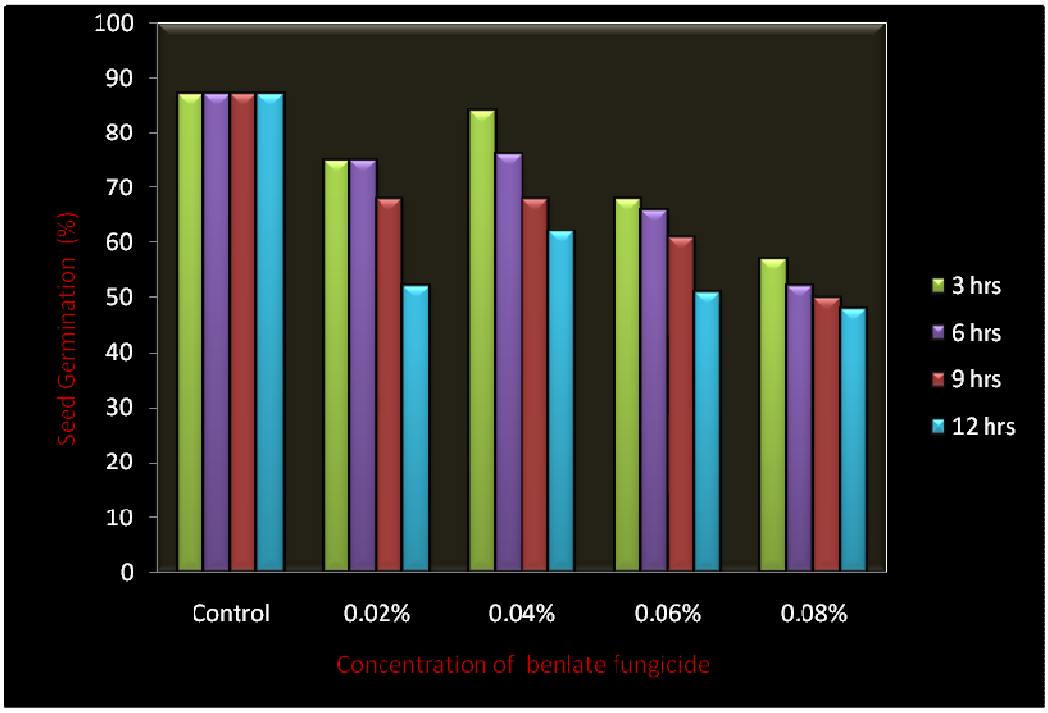

Figure 2
Effect of fungicide benlate on percentage seedling height in Allium cepa L. M_1 generation

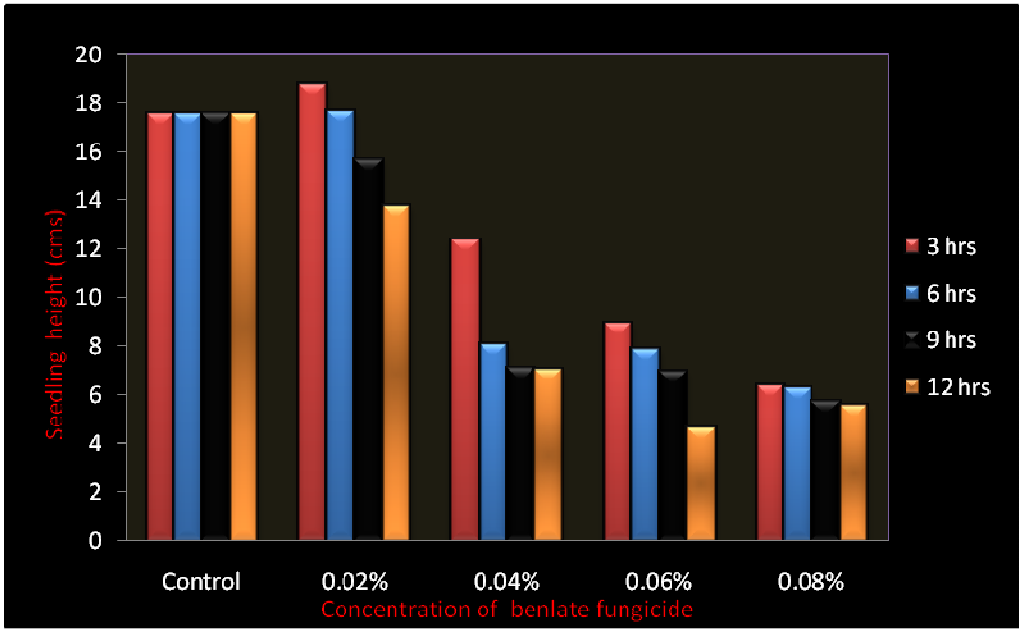

Figure 3
Effect of fungicide benlate on percentage root length in Allium cepa L. in M_1 generation

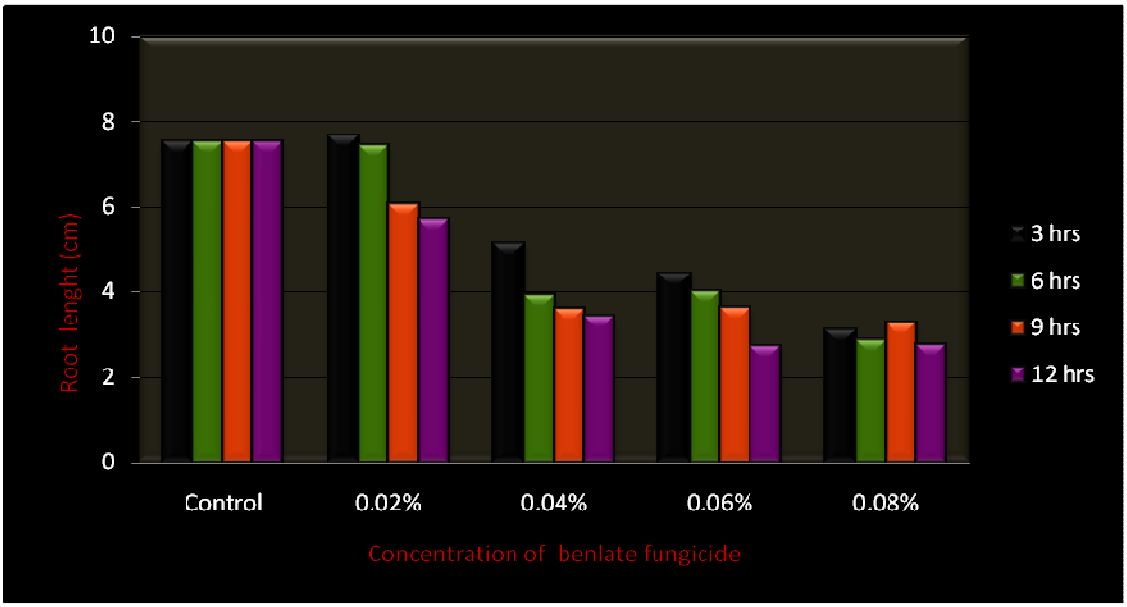

Table 1
Effect of benlate fungicide on percent of seed germination, Root Growth Inhibition (R.G.I.) Seedling Growth Inhibition (S.G.I.) in Allium cepa L.

Concentration of fungicide	Duration of treatment (hrs)	(%) of S.G.(cms)	R.L. (cms)	R.G.	R.G.I	S.H.	S.G.	S.G.I
0.02%	0	87.00	7.51	100.0	N.D	17.56	100.0	N.D
	3	75.00	7.67*	102.13*	N.D	18.79*	107.00	N.D
	6	75.00	7.43	98.93	1.07	17.70	100.79	N.D
	9	68.00	6.06	80.69	19.31	15.66	89.17	10.83
	12	52.00	5.70	75.89	24.11	13.77	78.41	21.59
0.04%	0	87.00	7.51	100.0	N.D	17.56	100.0	N.D
	3	84.00	5.13	68.30	31.70	12.43	70.72	29.28
	6	76.00	3.97	52.86	47.14	8.10	46.12	53.88
	9	68.00	3.60	47.93	52.07	7.12	40.54	59.46
	12	62.00	3.43	45.67	54.33	7.08	40.31	59.69
0.06%	0	87.00	7.51	100.0	N.D	17.56	100.0	N.D
	3	68.00	5.43	58.98	41.02	8.96	51.02	48.98
	6	66.00	4.02	53.52	46.48	7.89	44.93	55.07
	9	61.00	3.64	48.46	51.54	6.97	36.69	60.31
	12	51.00	2.72	36.21	63.79	4.62	26.30	73.07
0.08%	0	87.00	7.51	100.0	N.D	17.56	100.0	N.D
	3	57.00	3.09	41.45	58.86	6.39	36.38	66.49
	6	52.00	2.85	38.08	61.92	6.28	35.76	67.15
	9	50.00	3.27	43.54	56.46	5.74	32.68	70.41
	12	48.00	2.75	36.61	63.39	5.59	31.83	71.32

O-Control, * -Stimulating effect, R.L-Root Length, R.G-Root Growth, R.G.I. -Root Growth Inhibition, S.H-Seedling Height, S.G-Seedling Growth, S.G.I.-Seedling Growth Inhibition, N.D- Not Detected.

CONCLUSION

The present results concluded that these concentrations of Benlate fungicides suitable for germination of seedlings, but concentration higher than these recommended can be unsuitable for germination of seedlings.

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