J. Sci. Technol. Environ. Inform. 11(02): 756-763 | Hossen et al. (2022)
EISSN: 2409-7632, Journal home: www.journalbinet.com
Crossref: https://doi.org/10.18801/jstei.110222.76

JSTEI ONLINE JOURNAL Journal of Science, Technology & Environment Informatics
Journal BiNET Scientific Publication

Impact of different treatments on mat type seedling

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✉ Article received: 07.11.2021; Revised: 25.11.2021; First published online: 20 March, 2022.

Article Information

Key Words:
Biotic stress, Fungicide, MoP, Germination, Rolling quality and Seed treatment.

Access by Smart Phone

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ABSTRACT

Since seedlings are raised throughout the chilly months of November and December, a cold mitigation technique at the seedling stage is a must during Boro season. This study was conducted at Agricultural and Bio-systems Engineering Lab under Farm Power and Machinery department at Sylhet Agricultural University during the 2018-19 academic year. The study aimed to evaluate the effect of biotic or abiotic factors that influenced seedling germination and growth during Boro season. With three replications, the experiment was done in a two-factor design. As abiotic stress control variables, a total of six treatments were taken under two different thicknesses (0.04 mm and 0.08 mm) of white polythene shed covering day time alone (12 hours) and day and night time (24 hours). To reduce biotic stress on early seedlings grown in plastic trays, two fungicides (Atavo and Autostin) and MoP fertilizer were employed in germination and rolling quality of seedling mat, seedling elevated plastic trays showed significantly superior results compared to the traditional method. In the uncovered tray, where no treatment was given, the fungal infection was severe. Seedlings that covered both thicknesses of polythene (0.04 mm and 0.08 mm) and prepared seed with both fungicides (Atavo and Autostin) exhibited significant resistance to fungal attack. Consequently, 0.08 mm thick white polythene as a covering mechanism and MoP as a treatment method was advised for seedlings growing in Sylhet's cold weather. Pre-treated seedlings with Autostin and the biotic stress management component fungicide Atavo recommended to avoid fungal infestation.

Citation: Hossen, M. A., Tamanna, T. A., Mamun, M. R. A. and Shahed, A. B. M. (2022). Impact of different treatments on mat type seedling. Journal of Science, Technology and Environment Informatics, 11(02), 756-763.
Crossref: https://doi.org/10.18801/jstei.110222.76

I. Introduction

Rice is the staple food for the vast population in Bangladesh. The cost regarding rice cultivation must be minimized. With the increasing labor shortage, mechanization in rice production becomes a burning issue. Rice growing has traditionally been a labor-intensive process, with labor costs accounting for most rice production costs (Clayton, 2010). Direct seeding or transplanting are two methods for growing rice. When compared to traditional transplanting, mechanized rice seedling transplanting requires much less effort and time (1-2 $ha^{-1}person^{-1}days$) (0.07 $ha^{-1}person$ 1day) (IRRI, 2007). Plants are subjected to various biotic and abiotic challenges and they respond to these pressures through a variety of morphological, biochemical and molecular mechanisms, with evidence suggesting that their signaling routes interact (Nejat et al., 2017). As part of the natural ecosystem, biotic and abiotic stresses significantly impact crop output and cause danger to global food security. Plants in their natural habitats face a variety of biotic and abiotic stress factors, including biotrophic and necrotrophic fungi, bacteria, phytoplasmas and nematodes, and non-cellular pathogens (viruses and viroid's), as well as heat, cold, drought, salinity, mechanical wounds, high light intensity, freezing, heavy metals and metalloids (Mantri et al., 2014). Pests, parasites and diseases have been there since the dawn of time, generate biotic stressors in plants. Plant diseases are caused by fungi, bacteria, nematodes, and viruses, among many other pathogens. Abiotic stress, defined as the negative impact of non-living forces on living organisms in a particular environment, is the most significant cause of crop failure worldwide, with average yields of most major crops declining by more than 50%. Biotic stress becomes more harmful when it occurs together in combinations of abiotic stress factors (Mittler Ron, 2006). Each plant has its unique set of temperature requirements, which must be optimized for proper growth and development. In rice, the critical minimum temperature for shoot elongation ranges from 7^0C to 16^0C, and root elongation from 12^0C to 16^0C (Yoshida, 1981). Weed pests caused a maximum loss in seed yield 37.02%, followed by insect pests (27.9%) and disease pests (15.6%) (Mondal et al., 2017).

Fungicide might be worked against the natural incidence of seedling blight diseases during cold environments in Boro season. Seed treatments and spraying of fungicide on young seedlings could further be evaluated under the study. Muriate of potash (MoP) fertilizer and ash was also be evaluated to observe the effect on seedling raising in low temperature in controlling biotic stress along with low-cost white two different graded polythene shade. Fungicides are used to prevent rice infections, which can cause serious crop loss in terms of both quality and quantity. Rice accounts for 8.4% of the global fungicide market (Collins, 2007). The amount of the strain and the risk of resistance emerging are influenced by both the fungicide and the pathogen's characteristics. For mechanical transplanting of rice seedling, rolling quality of mat is also an important factor. For rolling up, the seedling mat must be of sufficient quality. The seedling mat's rolling quality is essential for feeding seedlings from rice transplanter tray to the main field (Anwar et al., 2020). This study aimed to identify suitable fungicides and evaluate the effect of MoP in controlling biotic stress on young seedlings and observe the rolling quality in block formation for mat type seedling raising.

II. Materials and Methods

Selection of Study Site

During the Boro season of 2018-19, this study was carried out at the Agricultural and Biosystems Engineering Lab under department of Farm Power and Machinery at Sylhet Agricultural University.

Weather Parameter

In Boro season, the temperature fluctuated often in comparison to day and night time. Inside and outside temperatures of the polythene shed were collected throughout the seedling growing period using a mercury thermometer. Two different grades of polythene sheet (0.04mm; 4 grade and 0.08mm: 8 grade) were used as covering media to control the abiotic stress.

General Information

Table 01. General information of experiment setup

Variety	Grains weight (per 1000g)	Germination (%)	Soil characteristics
BRRI dhan28	23.10	85%	Sandy clay loam (Sand 57.2%, Silt 15% and Clay 26.05%)

Experiment Design

The experiment used a two-factor design with three repetitions to manage biotic and abiotic stress on mat type rice seedlings (Table 02). The main factor was the covering mechanism (whole time, night

EISSN: 2409-7632, Journal home: www.journalbinet.com
Crossref: https://doi.org/10.18801/jstei.110222.76

time only and uncovered) of the seedling tray by white polythene of different thickness (0.04 and 0.08 mm) available in the markets while treating seeds as well as spray on young seedling immediate after immergence considered as sub-factor of the study. The treatments arrangement mentioned as follows-

Table 02. Experimental design

Main Factor A to control abiotic stress	Factor B to control biotic stress
P_1=Covering by 0.04 mm thickness polythene (24 hours) P_2=Covering by 0.04 mm thickness polythene (12 hours) P_3=Covering by 0.08 mm thickness polythene (24 hours) P_4=Covering by 0.08 mm thickness polythene (12 hours) P_5=Control (uncovered)	F_1=Fungicide-1 (seed treatment) F_2=Fungicide-2 (seed treatment) F_3=Fungicide-1 (spraying on seedling) F_4=Fungicide-2 (spraying on seedling) F_5=MOP (8-10g/tray) F_6=control (no fungicide).

Seeds were treated using the fungicide (F_1 and F_2) before 10-12 hours of germination. Fungicide was spread on young seedlings immediately after seedling emergence (F_3 to F_4) (Table 03). Seedling trays of treatments P_1 (0.04 mm thickness polythene) and P_3 (0.08 mm thickness polythene) were kept day and night time under the polythene shed during the growing periods, while P_2 (0.04 mm thickness polythene) and P_4 (0.08 mm thickness polythene) were kept night time only under the polythene shed. Other management were same for all treatments. Using the Statistix 10 application, collected data were analyzed as a 2-way factorial design (Statistix 10 software, 2013).

Table 03. Description of the fungicide applied as biotic stress control agent

Fungicide treatments	Brand name	Group	Active ingredient (AI)	Recommended dose
F_1	Atavo 75 WDG (Water Dispersible Granule)	Carbendazim	Imidacloprid 250 gm.+ Carbendazim 250 gm. + thriam 250 per kg	5% per 10 liter of water
F_2	Autostin 50 WDG	Carbendazim	Carbendazim 500 per kg	2-3 g. per liter of water

Mat Characteristics

The rolling capacity of the seedling mat was measured visually. The seedling mat's rolling quality was graded on a scale of 10 (Table 04).

Table 04. General information of experiment setup

Score	Condition		Score	Condition	
10	No Creak when folded		4	Major crack and difficult to roll	
8	Minor/ negligible cracks		2	Extreme crack/large size rupture in soil and sometimes difficult/ impossible to roll	
6	Medium crack but able to roll easily		1	Completely ruptured and enable to roll at all	

III. Results

Ambient Temperature and Relative Humidity

The temperature of rice seedlings cultivated in plastic trays is a significant component in their growth. Ambient temperature during seedling raising period is presented in Figure 01. The highest atmospheric temperature was observed at 34° C and the lowest temperature was 7° C during seedling growing period (Figure 01). The relative humidity during the growing period was collected from the local weather station, presented in Figure 02.

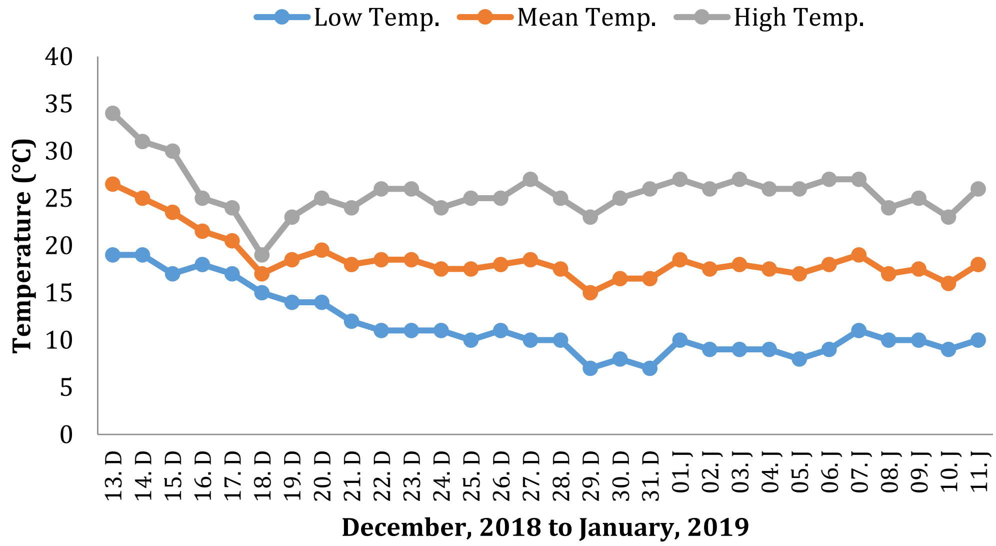

Figure 01. Ambient temperature during study period

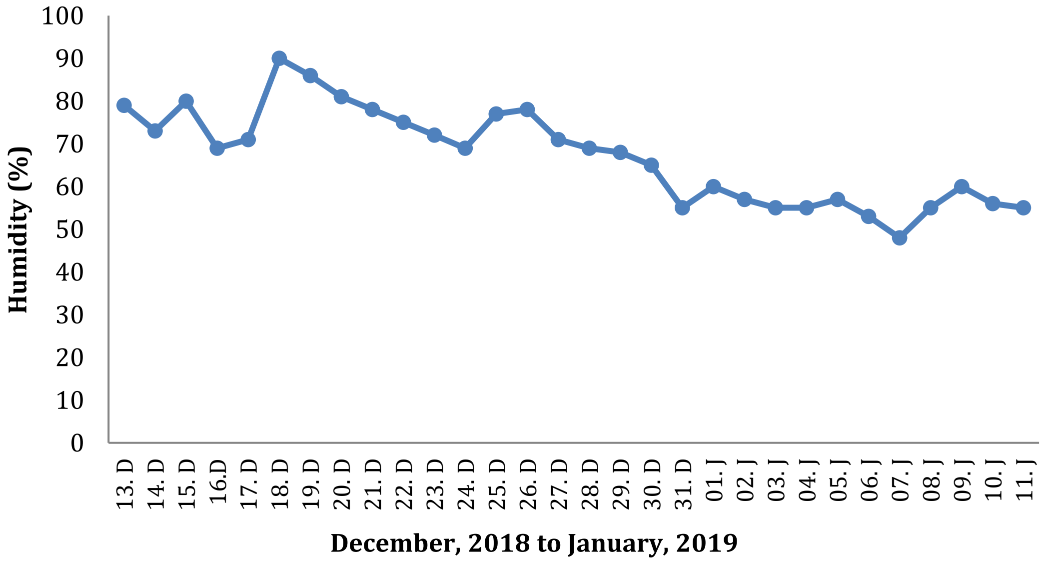

Figure 02. Humidity during study period

Temperature inside the Polythene Shed

Inside temperature of the two different thicknesses of polythene shed is provided in Figures 03 and Figures 04. As for abiotic stress control, the seedling trays which are covered by polythene 0.08 mm thickness, showed significantly better performance than uncovered trays. Fungal infection and seedling density were high in covered treys than uncovered treys.

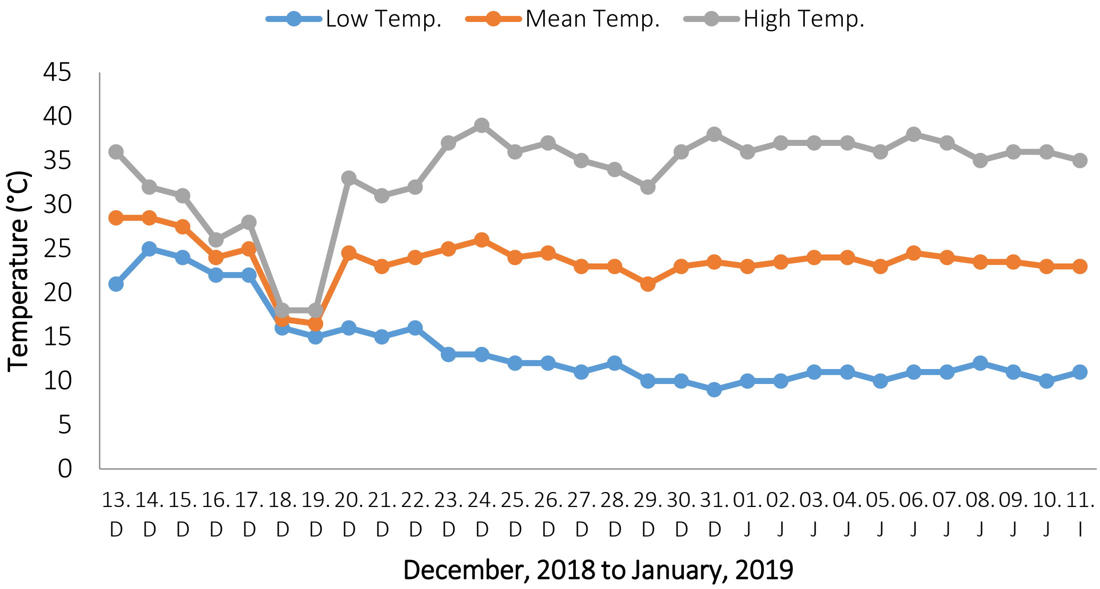

Figure 03. Temperature inside the 4 grade (0.04 mm thickness) polythene

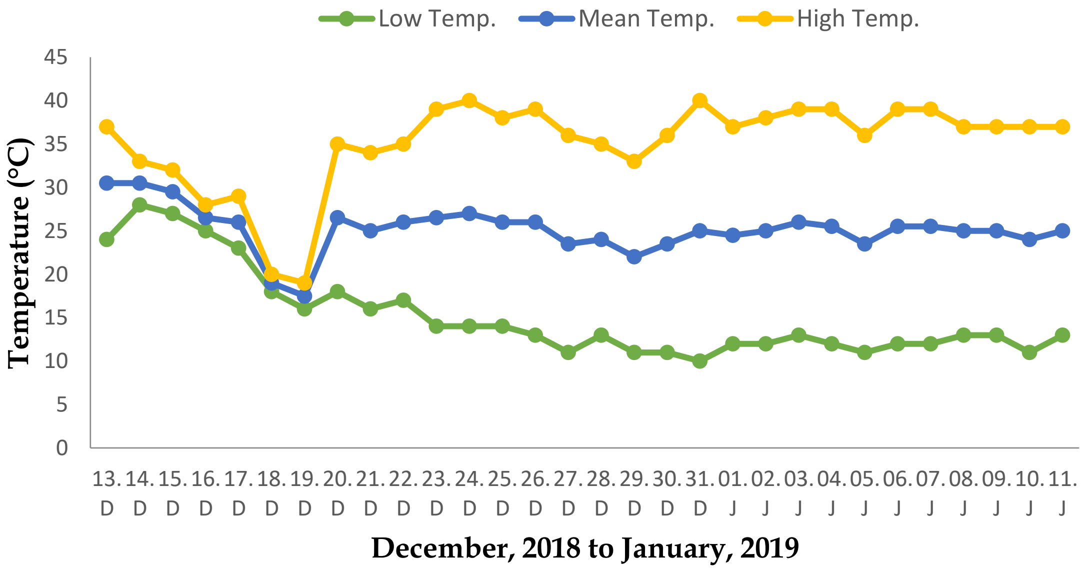

Figure 04. Temperature inside the 8 grade (0.08 mm thickness) polythene

Fungal infection

The interaction effect of abiotic stress factors (covering mode and method) and biotic stress factors (seed and seedling treatment) on seedling density was not significant. On the other hand, the combined effect of abiotic stress and biotic stress component significantly impacted fungal infection (Table 05). Fungal infection was severe in uncovered tray where no treatment was provided. On the other hand seedling covered both thicknesses (0.04 mm and 0.08 mm) of polythene and pretreated seed with both fungicides (Atavo and Autostin) showed noticeable results against fungal attack.

Among the abiotic stress control factors (mode and method of covering), P_5 (16.66) scored significantly higher infection. Meanwhile, P_4 (3.05) scored significantly lower percentage, followed by P_1 (4.44) and P_2 (3.05) (Table 05). A significantly higher and lower percentage of plants was infected for biotic stress control factors F_6 and F_1 to F_6, respectively. On the other hand, F_6 (13) biotic stress factor (seed and seedling treated) scored significantly higher value. A significantly lower value was observed for biotic stress F_1 to F_5 (3.33 to 8.33) (Table 05).

Table 05. Effect of abiotic and biotic stress control factors on fungal infection on seedling at 30 days after seeds sowing

Biotic stress control factors (Seeds and seedling treatment)	Abiotic stress control factors (mode and method of covering)					Mean
	P_1 (day and night time)	P_2 (night time only)	P_3 (day and night time)	P_4 (night time only)	P_5 (uncovered)	
F_1	1.6	1.6	5	0	10	3.6
F_2	1.6	0	3.3	1.6	10	3.3
F_3	5	3.3	5	3.3	18.3	7
F_4	5	1.6	8.3	3.3	16.6	7
F_5	5	5	10	5	16.6	8.3
F_6	8.3	6.6	16.6	5	28.3	13
Mean	4.4	3.0	8.0	3.0	16.6	
% of cv	48.63					
LoS	A=* , B=* and A× B = NS					
$LSD_{0.05}$	A= 2.28 and B= 2.50					

Note: ***-significant at 1 %, -significant at 5 %, NS-Not significant, LoS-Level of significance,

Rolling efficiency

The two-way interaction impact of abiotic stress control variables and biotic stress factors, as well as the single effects of abiotic stress and biotic stress factor, had a substantial effect on rolling resistance. (Table 06). The rolling quality of seedling mat was significantly good when seedling was covered both day and night by polythene shed of both thickness and almost every treatment was found suitable. Inversely uncovered treys showed lower rolling quality in almost all treatments.

Table 06. Effect of abiotic and biotic stress control factors on rolling resistance on seedling at 30 days after seeds sowing

Biotic stress control factor (Seeds and seedling treatment)	Abiotic stress control factor (mode and method of covering)					Mean
	P_1 (day and night time)	P_2 (night time only)	P_3 (day and night time)	P_4 (night time only)	P_5 (uncovered)	
F_1	9.3	8.6	8	10	3.3	7.8
F_2	9.3	9.3	9.3	10	8	9.2
F_3	8.6	8	8	8.6	4	7.4
F_4	7.3	10	8.6	10	3.3	7.8
F_5	4.6	9.3	9.3	10	4	7.4
F_6	9.3	9.3	9.3	10	6	8.8
Mean	8.1	9.1	8.7	9.7	4.7	
% of cv	11.75					
LoS	A= *, B= * and A× B = *					
$LSD_{0.05}$	A= 0.63, B= 0.69 and A× B= 1.55					

Note: ***-significant at 1 %, -significant at 5 %, NS-Not significant, LoS-Level of significance,

Among the abiotic stress control factors (mode and method of covering), P_4 scored significantly higher value (9.77). Meanwhile, P_5 (4.77) scored significantly lower value, followed by P_1 to P_3 (8.11 to 8.77) (Table 06). On the other hand, biotic stress factors F_2 (9.2) and F_6 (8.8) scored significantly higher values. Significantly lower values were observed for F_1 (7.8), F_3 to F_5 (7.46 to7.86) (Table 06)

IV. Discussion

In this study, temperature is taken as an important parameter for Boro rice seedling raising. The highest temperature (40˚C) was observed inside 0.08 mm thick white polythene shed during day and night. In the meantime, the lowest temperature (9˚C) was observed 0.04 mm thick white polythene shed during nighttime only. In another study, the highest and the lowest temperatures were observed at 0.04 mm thick black polythene shed during day-night and 0.08 mm thick black polythene shed during day-night respectively (Kamruzzaman et al. 2014). Both thickness of white polythene was used to protect young seedlings from cold weather and fungal infection. Seedling density and rolling quality showed best result for seedlings covered by 0.08 mm thick polythene shed.

As for fungal infection, seedlings covered by 0.08 mm polythene shed day and night showed almost no infection. Seedling covered by 0.04 mm thick polythene shed day and night time also showed promising results as well. For best method of covering 0.08 mm white polythene was found best for cold weather in comparison to uncovered seedling trays. Seedling trays pre-treated with both fungicide (Atavo and Autostin) showed significantly less fungal infection than sprayed and MoP treated seedlings. Seedlings with no treatment were severely affected by fungus and birds. The interaction and single effects of soil type, organic component, and mixing rate were identified during the Boro season of 2019. In terms of mechanical properties, when the organic component's mixing rate with the base soil increased, the seedling mat's rolling capacity decreased and fungal infection increased (Shahed et al., 2020).

Seedling mat rolling quality was greatly enhanced when polythene sheds of various thicknesses covered seedlings throughout the day and night, and practically every treatment was determined to be appropriate. Uncovered trays, on the other hand, showed inferior rolling quality despite treatment. Apart from rice bran, the seedling mat's rolling quality deteriorated when organic fertilizer was increased. The soil's bounding strength also reduced as the amount of organic fertilizer was raised (Hossen et al., 2018).

This research aimed to find out if there was any fungal infection during the seedling development stage during the Boro season's cold weather. The rolling quality is of mat was also found significant on covered and controlled conditions. Seedling covering mechanism by 0.08 mm thick polythene shed covered day and night showed the best result for all parameters as subfactor seeds and seedling mechanism showed best result with both fungicides (Atavo and Autostin) when seeds pre-treated before sowing and MoP by spraying in young seedling. So, at last, 0.08 mm thick white polythene was recommended for protecting seedlings from cold weather and fungal infestation in Boro season. As well as for biotic stress control factor fungicide Atavo, Autostin recommended in pre-treated seeds for preventing fungal infestation.

V. Conclusion

In the case of fungicides 1 and 2 (Atavo and Autostin), seed that had been pre-treated with fungicide performed better than seed that had been sprayed after ten days on newborn seedlings. As for fungal infestation, combined effect of 0.08 mm polythene shed covered nighttime and seed treatment by fungicide 1 (Atavo 75 WDG) showed the best performance while trays were no cover and control condition showed the worst result. On covered and controlled conditions, the mat's rolling quality was also shown to be considerable.

Acknowledgements

The Bangladesh Rice Research Institute (BRRI) provided technical and financial assistance for this work, which we appreciate. Also, a huge thanks to the instructors and employees at Sylhet Agricultural University's Department of Farm Power and Machinery for their unwavering support.

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HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jstei.110222.76

MLA

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APA

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Vancouver

Hossen, MA, Tamanna, TA, Mamun, MRA and Shahed, ABM. Impact of different treatments on mat type seedling. Journal of Science, Technology and Environment Informatics. 2022 March, 11(02):756-763.