



## Pre-Sowing Seed Treatment of Selected Botanical Extracts and Biofertilizers on Growth, Yield and Yield Attributing Traits of Mustard (*Brassica juncea*.L)

Busireddy Sai Harsha Vardhan Reddy <sup>a\*∞</sup>, Bineeta Michael Bara <sup>a#</sup>,  
Prashant Kumar Rai <sup>a#</sup>, Vaidurya Pratap Sahi <sup>a†</sup>, Samir Ebson Topno <sup>b‡</sup>  
and Biswarup Mehera <sup>c‡</sup>

<sup>a</sup> Department of Genetics and Plant Breeding, NAI, SHUATS, Prayagraj, Uttar Pradesh, India.

<sup>b</sup> Department of Horticulture, NAI, SHUATS, Prayagraj, Uttar Pradesh, India.

<sup>c</sup> Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India.

### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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### ABSTRACT

The present investigation was carried out for "Pre-sowing seed treatments of selected botanicals extract and biofertilizers on growth, yield and yield attributing traits of Mustard (*Brassica juncea* L.)". For this purpose, 13 priming treatments including control on Mustard seeds variety were used to study under field conditions during rabi, 2021-22. Field experiment was laid out in Randomized Block Design (RBD) with three replications respectively during Rabi 2021-22. Analysis for the data in field experiment revealed significance mean sum of squares due to seed priming treatments for all the characters under study. In order to standardize method of seed priming specific to mustard crop and they were evaluated by screening a range of duration and concentration Viz T<sub>0</sub>- Control, T<sub>1</sub> Neem Leaf Extract 5% (6Hrs), T<sub>2</sub> Neem Leaf Extract 10%(6Hrs), T<sub>3</sub> Moringa Leaf Extract 5%

<sup>∞</sup> M.Sc. Scholar,

<sup>#</sup>Assistant Professor,

<sup>†</sup>Associate Professor and Head

<sup>‡</sup>Associate Professor,

\*Corresponding author: E-mail: [sunnyreddy9313@gmail.com](mailto:sunnyreddy9313@gmail.com);

(6Hrs), T<sub>4</sub> Moringa Leaf Extract(10%6Hrs), T<sub>5</sub> *Trichoderma viridae* 0.1%(6Hrs), T<sub>6</sub> *Trichoderma viridae* 0.3%(6Hrs), T<sub>7</sub> Azosprillum 0.1%(6Hrs), T<sub>8</sub> Azosprillum 0.3%(6Hrs), T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs, T<sub>10</sub> *Trichoderma viridae* + Azosprillum (0.1%+0.1%), T<sub>10</sub> *Trichoderma viridae* + Azosprillum (0.1%+0.1%), T<sub>11</sub> Neem Leaf Extract + *Trichoderma viridae* (3% +0.1%), T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) To find out Influence of different seed treatment on growth, yield and seed quality parameters of mustard showed that significant treatment Field emergence (%), Plant height (30,60,90 DAS), Days to 50% flowering, Number of branches per plant, Number of silique per plant, Number of seeds per silique, Seed yield per plant (g), Seed yield per plot (g), Biological yield (g), Harvest index. The study helps to improve the quality to improve of seed with help of seed different Leaf extracts and Biofertilizers priming treatment which are cost effective and economic, non- toxic, ecofriendly sources. Pre- sowing treatment with It is concluded from the present study that the seeds of Mustard (Variety - sonalika) were treated with T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs enhanced the Field emergence percentage, Plant height (cm), Number of branches per plant, Number of silique per plant, Number of seeds per silique, Seed yield per plant, Seed yield per plot, Biological yield, Harvest index followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) and T<sub>4</sub> Moringa Leaf Extract(10%6Hrs) as compared to control ( untreated ) seeds.

**Keywords:** Mustard; priming; seed treatment; leaf extracts; biofertilizers.

## 1. INTRODUCTION

Mustard is an annual, cool-season specialty cash crop that has a short growing season and is commonly grown in rotation with small grains. Mustard is the name given to two closely related species in the Brassica family. Yellow mustard, *Sinapis alba* L. (also identified as *Brassica hirta* L.) and Indian, oriental or brown mustard, *Brassica juncea* L. Mustard is native to temperate regions of Europe and has its historic base there. The estimated area, production and yield of rapeseed-mustard in the world was 36.59 million hectares (mha), 72.37 million tonnes (mt) and 1980 kg / ha, respectively, during 2018-19. Globally, India account for 19.8 % and 9.8% of the total acreage and production (USDA). During the last eight years, there has been a considerable increase in productivity from 1840 kg/ha in 2010-11 to 1980 kg/ha in 2018-19 and production has also increased from 61.64 m t in 2010-11 to 72.42 m t in 2018-19.

## 2. MATERIALS AND METHODS

The present investigation was carried out to study the effect of Pre-sowing seed treatments of selected Botanical extracts and biofertilizers on growth, yield and yield attributing traits of mustard (*Brassica juncea* L.) at the central research field of Seed Science and Technology in the Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Science, Naini Agriculture Institute, Prayagraj (U.P). Field

experiment was laid out in Randomized Block Design (RBD) with treatment material consists of 12 treatments and untreated (control) seed of mustard and three replications respectively during Rabi 2021-22. viz., T<sub>0</sub>- Control, T<sub>1</sub> Neem Leaf Extract 5% (6Hrs), T<sub>2</sub> Neem Leaf Extract 10%(6Hrs), T<sub>3</sub> Moringa Leaf Extract 5% (6Hrs), T<sub>4</sub> Moringa Leaf Extract(10% 6Hrs), T<sub>5</sub> *Trichoderma viridae* 0.1%(6Hrs), T<sub>6</sub> *Trichoderma viridae* 0.3%(6Hrs), T<sub>7</sub> Azosprillum 0.1%(6Hrs), T<sub>8</sub> Azosprillum 0.3%(6Hrs), T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract (5% +3%) 6hrs, T<sub>10</sub> *Trichoderma viridae* + Azosprillum (0.1%+0.1%), T<sub>10</sub> *Trichoderma viridae* + Azosprillum (0.1%+0.1%), T<sub>11</sub> Neem Leaf Extract + *Trichoderma viridae* (3% +0.1%), T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3%+0.1%) with the soaking durations of 6hrs with water. The unfortified seed served as control. The soaked seeds were surface dried for one day and were evaluated for the growth, yield attributing parameters viz., Maximum field emergence percentage at 4DAS, 7DAS, 10DAS plant height (30,60,90DAS), number of branches per plant, days to 50% flowering, days to maturity, number of silique per plant, number of seeds per silique, seed yield per plant(g), seed yield per plot(g), biological yield (g), harvest index(%) to find the best treatment results was observed in mustard variety (sonalika).

## 3. RESULTS AND DISCUSSION

The mean performance of field emergence ranged from 81% to 98 % with mean value of 82.78 %. Significantly maximum percentage of

field emergence (84.72%) was recorded in the treatment T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract (5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum (3% +0.1%) ,T<sub>5</sub> - Moringa Leaf Extract 5% (6Hrs) (83.33%) and T<sub>8</sub> Azosprillum 0.3%(6Hrs) (83.33%). Minimum field emergence was recorded by T<sub>0</sub> – Control (72.22%). The mean performance of field emergence ranged from 72.22% to 84.72 % with mean value of 82.78 %.Significantly maximum highest percentage of field emergence (94.44%) was recorded T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (88.88 %), T<sub>4</sub> Moringa Leaf Extract(10%Hrs) (87.5) and T<sub>8</sub> Azosprillum 0.3%(6Hrs) (83.33%). Minimum field emergence was recorded by T<sub>0</sub> – Control (79.16 %). The mean performance of field emergence ranged from 81.94% to 98.61 % with mean value of 88.08 %.Significantly maximum highest percentage of field emergence (98.61%) was recorded T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5%+3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (93.06 %), T<sub>4</sub> Moringa Leaf Extract(10%) (6Hrs) (90.28%) and T<sub>6</sub> *Trichoderma viridae* 0.3% (6Hrs) (88.89%). Minimum field emergence was recorded by T<sub>0</sub> – Control (81.94%). The mean performance of plant height(cm) at 30DAS ranged from 21.97 cm to 36.57 cm with mean value of 59.84 cm. Significantly, maximum height of plant (cm) 30DAS ( 36.57 cm) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (31.47 cm), T<sub>4</sub> Moringa Leaf Extract(10%) (26.50 cm) and T<sub>8</sub> Azosprillum 0.3% (6Hrs) (26.37cm). Minimum plant height was recorded by T<sub>0</sub>–Control (21.97cm). The mean performance of plant height(cm) at 60DAS ranged from 53.43 cm to 70.73 cm with mean value of 59.84 cm. Significantly, maximum height of plant (70.73 cm) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%)(66.77 cm), T<sub>4</sub> Moringa Leaf Extract(10%) (64.83 cm) and T<sub>5</sub> *Trichoderma viridae* 0.1%(6Hrs) (59.60 cm). Minimum plant height was recorded by T<sub>0</sub>–Control (53.43 cm). The mean performance of plant height(cm) at 90DAS ranged from 85.57 cm to 108.77 cm with mean value of 92.23 cm.

Significantly, maximum height of plant (108.77 cm) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract (5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (101.77 cm), T<sub>4</sub> Moringa Leaf Extract (10%Hrs) (95.43cm) and T<sub>3</sub> Moringa Leaf Extract 5% (6Hrs) (91.60cm). Minimum plant height was recorded by T<sub>0</sub>–Control (85.57 cm). The mean performance of number of branches per plant ranged from 4.91 to 5.75 with mean value of 5.16 Significantly, maximum number of branches (5.75) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum (3%+0.1%) (5.68), T<sub>4</sub> Moringa Leaf Extract(10%) (5.60) , T<sub>2</sub> Neem Leaf Extract 10%(6Hrs)(5.25). Minimum number of branches was recorded by T<sub>0</sub>– Control (4.91). The mean performance of Days to 50% flowering per plant ranged from 41.78 to 48.69 with mean value of 44.35 Significantly, maximum days to 50% flowering (41.78) was recorded by T<sub>0</sub>–Control and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (43.41), T<sub>7</sub> Azosprillum 0.1% (6Hrs) (44.24) and Minimum was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract (5% +3%) 6hrs (47.78). The mean performance of Days to Maturity ranged from 125.33 to 136.67 with mean value of 130.18 Significantly, maximum days to Maturity (136.67) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3%+0.1%) (135.33), T<sub>4</sub> Moringa Leaf Extract (10%) (130.33) and Minimum was recorded by T<sub>0</sub>–Control (125.33). The mean performance of number of silique per plant ranged from 54.20 to 71.77 with mean value of 61.82. Significantly, maximum number of silique (71.77) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (70.43), T<sub>4</sub> Moringa Leaf Extract(10%Hrs) (6Hrs) (66.87), Minimum number of silique per plant was recorded by T<sub>0</sub>–Control (54.20). The mean performance of number of seeds per silique ranged from 8.11 to 11.15 with mean value of 9.32. Significantly maximum number of seeds per silique (11.15) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract (5% +3%) 6hrs and it was followed by, T<sub>12</sub> Moringa Leaf Extract + Azosprillum (3% +0.1%) (10.78), T<sub>4</sub> Moringa

**Table 1. ANOVA for effect of treatments on growth and yield parameters in Mustard**

Characters	Mean Sum of Squares		
	Treatment df(12)	Replication df(2)	Error df(24)
FIELD EMERGENCE (%) at 4DAS	119.3	54.01*	12.724
FIELD EMERGENCE (%) at 7 <sup>th</sup> DAS	96.59	37.61*	12.68
FIELD EMERGENCE (%) at 10 <sup>th</sup> DAS	123.31	56.46*	25.41
PLANT HEIGHT (30DAYS)	3.16	49.87*	2.97
PLANT HEIGHT (60DAYS)	20.18	76.27*	11.23
PLANT HEIGHT (90DAYS)	13.26	128.868	16.00
NUMBER OF BRANCHES / PLANTS AT30DAS	0.345	0.422*	0.672
DAYS TO 50% FLOWERING	0.944	12.00*	0.273
DAYS TO MATURITY	35.25	34.70*	11.95
NO OF SILIQUA PER PLANT	4.39	406.63*	11.70
NO OF SEEDS PER SILIQUA	0.134	2.67*	0.23
SEED YIELD PER PLANT	0.007	0.278*	0.015
SEED YIELD PER PLOT	4.59	90.78*	3.70
BIOLOGICAL YIELD	0.131	0.672*	0.107
HARVEST INDEX	0.686	19.843*	3.20

\*Significant at 5% level of significance

Leaf Extract(10%Hrs) (10.71), T2 Neem Leaf Extract 10%(6Hrs) (9.33) and Minimum number of seeds per silique was recorded by T<sub>0</sub>– Control (8.11). The mean performance of seed yield per plant ranged from 1.53 g to 2.48 g with mean value of 1.78 g. Significantly, maximum seed yield per plant (2.48 g) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (2.26), T<sub>4</sub> Moringa Leaf Extract(10%Hrs) (2.10 g), T<sub>3</sub> - Neem- Leaf Extract 5% (6Hrs) (1.78g), T<sub>8</sub> Azosprillum 0.3% (6Hrs), (1.74g) and. Minimum seed yield per plant was recorded by T<sub>0</sub>– Control (1.53 g). The mean performance of seed yield per plot ranged from 37.53 g to 59.16 g with mean value of 43.93g. Significantly, maximum seed yield per plot (59.16g) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5%+3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum (3%+0.1%) (46.65g), T<sub>4</sub> Moringa Leaf Extract(10%Hrs) (46.55g) and Minimum seed yield per plot was recorded by T<sub>0</sub>– Control (37.53g). The mean performance of biological yield ranged from 7.58 g to 9.17 g with mean value of 8.27 g. Significantly, maximum biological yield (9.17g) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3%+0.1%) (8.92), T<sub>4</sub> Moringa Leaf Extract(10%Hrs) (8.68 g). Minimum biological yield was recorded by T<sub>0</sub>(8.27). The

mean performance of harvest index ranged from 20.18% to 27.05% with mean value of 21.41 %. Significantly, maximum harvest index (27.05 %) was recorded by T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs (8.47%)and it was followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) (25.37 %), T<sub>4</sub> Moringa Leaf Extract(10%Hrs) (24.24%), T<sub>8</sub> Azosprillum 0.3%(6Hrs) (22.11%), Minimum harvest index was recorded by T<sub>0</sub>– Control (5.57%). This was might be due to better water imbibition due to hydro priming and priming with Moringa leaf extract (MLE), because seeds have a thick outer coat and they might take more time to start germination if sown unprimed because water imbibition is the first step of germination and insufficient moisture level hampers the germination process. These results are in agreement with those obtained by Iqbal [2014] and Iqbal et al. [2014], who recorded positive effects of Moringa leaf extract (MLE) on growth of plants The significantly higher final germination given by Moringa leaf extract be due to zeatin which is complete confirmation with those of Phiri and Mbewe [1], who observed more germination and seedling growth triggered by zeatin. These results are in agreement with those obtained by Muhammad Aamir Iqbal [2014] who recorded positive effects of Moringa leaf extract (MLE) on growth of plants, These findings are also supported by the findings of Lee et al. [2] who reported that *Moringa oleifera* leaf extract accelerate the growth of young plants, strengthen plants, improve resistance to

**Table 2. Pre harvest observation mean performance of Mustard for growth and yield parameters**

Treatment	Field emergence percentage			Plant Height(cm)			Number of branches/plant	Days to 50% flowering	Day to Maturity	Number of siliqua / plant	Number of seeds /siliqua
	4DAS	7DAS	10DAS	30DAS	60DAS	90DAS					
	T <sub>0</sub>	72	79	81	21.97	53.43					
T <sub>1</sub>	80	83	86	24.17	57.10	85.80	5.25	42.93	131.33	60.33	9.33
T <sub>2</sub>	81	86	86	23.77	56.03	88.93	5.05	42.43	128.33	58.77	8.65
T <sub>3</sub>	79	83	83	23.20	55.67	91.60	4.46	42.98	128.67	53.17	9.17
T <sub>4</sub>	83	87	90	26.50	64.83	95.43	5.60	48.69	130.33	68.33	10.71
T <sub>5</sub>	80	84	88	23.77	59.60	90.77	5.03	44.16	127.33	66.87	8.80
T <sub>6</sub>	83	87	88	24.93	57.80	87.50	4.78	42.83	129.33	63.30	9.01
T <sub>7</sub>	81	86	87	22.80	57.27	89.67	4.87	44.24	126.33	56.93	8.95
T <sub>8</sub>	83	84	84	26.37	58.37	92.17	5.29	47.26	130.33	61.00	8.65
T <sub>9</sub>	84	94	98	36.57	70.73	108.77	5.75	47.78	136.67	71.77	11.15
T <sub>10</sub>	80	84	86	24.27	57.00	88.67	5.07	44.09	134.00	60.20	9.11
T <sub>11</sub>	81	86	88	23.23	63.30	92.30	5.37	43.93	129.00	58.40	8.76
T <sub>12</sub>	84	88	93	31.47	66.77	101.77	5.68	43.41	135.33	70.43	10.78
SE(m)	4.35	4.13	5.73	1.00	1.94	2.31	0.15	0.30	2.00	1.74	0.28
CV	6.01	6	8.49	6.73	5.60	4.34	5.20	1.19	2.66	4.88	5.22
C.D	2.05	2.05	2.91	2.91	5.65	6.74	0.45	0.88	5.82	5.09	0.82

**Table 3. Post harvesting observation mean performance of Mustard for growth and yield parameters**

Treatment	Seed yield per plant(g)	Seed yield per plot(g)	Biological yield(g)	Harvest index
T <sub>0</sub>	9.73	37.53	175.5	5.57
T <sub>1</sub>	10.43	43.54	174.97	6.53
T <sub>2</sub>	10.46	42.11	144.4	5.17
T <sub>3</sub>	11.49	46.55	181.73	6.34
T <sub>4</sub>	12.5	46.65	192.17	7.49
T <sub>5</sub>	11.34	43.28	185.17	6.11
T <sub>6</sub>	12.46	41.27	147.67	5.79
T <sub>7</sub>	10.62	42.18	183.9	5.79
T <sub>8</sub>	12.4	40.19	165.73	7.25
T <sub>9</sub>	14.3	59.16	246.97	8.47
T <sub>10</sub>	10.26	40.35	163.23	6.29
T <sub>11</sub>	9.94	40.03	175.2	5.67
T <sub>12</sub>	13.66	48.41	202.57	7.81
<b>SE(m)</b>	<b>0.66</b>	<b>1.11</b>	<b>16.67</b>	<b>4.22</b>
<b>CV</b>	<b>9.88</b>	<b>4.38</b>	<b>16.79</b>	<b>95.47</b>
<b>C.D</b>	<b>1.92</b>	<b>3.24</b>	<b>49.53</b>	<b>12.32</b>

pests and diseases, increase leaf area duration, increase number of roots. These findings are in line with Ella and Zapata et al., [1991], who reported more seed production due to vigorous vegetative growth of crops as a result of exogenous application of phytohormones. This was probably due to the presence of growth promoting hormones as well as other macro and micro nutrient which increased the cell division and there was more root and shoot length. These results are in line with Akinbode and Ikuton [2008], Makkar and Becker et al., [3] and Ella et al. [1991], who described more physiological growth and development with the application of moringa leaf extract. The highest number of leaves and roots were produced by plants that were treated with 5% moringa leaf extract (MLE) and the minimum values were given by control treatment. This was probably due to the growth promoting effect of various nutrients present in moringa leaf extract. These findings are in agreement with Ambler et al. [4]. Bashir et al. [5] revealed that moringa leaf extract significantly increased the average plant height, leaves number, number of branches and yield of tomato plant. Oluwabenga and Odeghe [6] mentioned that sweet bell pepper plant height; number of leaves, fruit weight and yield were significantly influenced by the application of moringa leaf extract. Aluko [7] reported that the highest values of pepper plant growth and yield parameters were obtained with MLE foliar application at concentration of (1:20). These results are in accordance with the findings of Lakra et al. [8]. However, plant height, number

of seeds/silique, length of silique and test weights remained unaffected due to planting geometry. These findings are in positive assurance with the earlier findings of Jarman Gadi et al. [9], Lekhraj Jat et al. [10], Yared Semahegn Belete et al. [11]). The results of present study were also supported by the earlier findings of Alam et al. [12] in mustard. These findings were in conformity with those of Khajuria et al. [13] and Lakra et al. [8]. These findings are in agreement with Phiri and Mbewe [1] and Qayyum et al. [2007], who reported more yield and harvest index of a variety of oil seed and other cereal crops with exogenous application of phytohormones especially zeatin and brassinosteroids.

#### 4. CONCLUSION

Pre-sowing treatment with It is concluded from the present study that the seeds of Mustard (Variety- sonalika) were treated with T<sub>9</sub> Neem Leaf Extract + Moringa Leaf Extract(5% +3%) 6hrs enhanced the Field emergence percentage, Plant height (cm), Number of branches per plant, Number of silique per plant, Number of seeds per silique, Seed yield per plant(g), Seed yield per plot(g), Biological yield(g), Harvest index(%) followed by T<sub>12</sub> Moringa Leaf Extract + Azosprillum(3% +0.1%) and T<sub>4</sub> Moringa Leaf Extract(10%) as compared to control (untreated) seeds. These conclusions are based on the results of crop duration investigation and therefore further investigation is needed to arrive at valid recommendation.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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