International Journal of Plant & Soil Science

34(21): 486-494, 2022; Article no.IJPSS.89716
ISSN: 2320-7035

Impact of Different Seed Priming Methods with Bio Fertilizers and Botanicals on Growth, Yield and Yield Attributing Traits of Sweet Corn (*Zea mays* L.)

Kariyappa Sankar Narayana [a*], Bineeta M. Bara [a] and Uppe Swathi Priya [a]

[a] Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, U.P, India.

Authors' contributions

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

Article Information

DOI: 10.9734/IJPSS/2022/v34i2131291

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/89716

Original Research Article

Received 04 May 2022
Accepted 16 July 2022
Published 18 July 2022

ABSTRACT

A field experiment was conducted during Rabi season of 2021-2022 at Field Experimentation Center of Department of Genetics and Plant Breeding, SHUATS, Prayagraj, U.P. The experiment was laid out in Randomized Block Design, with a view to find out the suitable Seed priming methods with bio fertilizers and botanicals on growth, yield and yield attributing traits of Sweet corn (*Zea mays* L.). For this purpose, 13 priming methods including control were used to study under field conditions. The results indicated that Field emergence percentage at 4,7, and 10 DAS, Plant height at 30, 45, 60 and at harvest DAS, Days to 50% Tasselling, Days to 50% Silking, Days to Maturity, Cob length (cm), Cob girth (cm), Number of cobs per plant, Number of rows per cob, Number of grains per row, Seed index (g), Seed yield per plant (g), Seed yield per plot (t/ha), Stover yield (t/h), Biological yield (t/ha) and harvest index (%), were significantly recorded highest in Azospirillum @ 30g (12 hours) followed by Azospirillum @ 20g (12 hours) when compared to other treatments. It is suggested that seed priming with Azospirillum @ 30g (12 hours) is used for improving growth, yield and yield attributing traits of sweet corn could be recommended.

Keywords: Sweet corn; seed priming; azospirillum; moringa leaf extract; yield attributes.

**Corresponding author: E-mail: sankarkariyappa@gmail.com;*

1. INTRODUCTION

Maize (*Zea mays* L.) is a C4 plant belonging to family Poaceae, Chromosome No. (2n=20) This crop is called as miracle crop and queen of cereals due to its high productivity [1]. It is third most important cereal crop after rice and wheat and is being grown throughout the year but mainly as Kharif crop. In India maize is grown in 9.86 M ha area with a production and productivity of 31.51 million tones and 3,195 kg/h respectively contributing 2.53% share over world's production (Directorate of Economics and Statistics 2021).

Since, maize is an industrial important crop, the demand for maize seed is more. On realizing the importance of maize in seed industry, the private seed companies are now concentrating more on maize hybrid development and because of continuous research many hybrids were also developed. Among various specialty corns, Sweet corn (*Zea mays* L.) is a mutant type with one or more recessive alleles in homozygous condition, which enables the endosperm to accumulate twice the sugar content as that of corn and controls the conversion of sugar into starch inside the endosperm of kernel. Its consumption at immature stage as roasted and boiled ears is a popular practice as the kernels are sweet (content 12–20% sugar), creamy, tender and crispy. After harvesting green cobs, the plants of sweet corn are used as green fresh or dry fodder. This specialty corn with its high market value is gaining popularity and now a day's its cultivation is the first choice of the farmers [2]. Sweet corn can be grown all-round the year under irrigated condition, enabling it to fit in intensive cropping systems.

For existence of any variety or hybrid, timely supply of quality seed is foremost requirement. Good quality seed is the key for successful agriculture to produce a vigorous seedling ensuring higher yield [3]. In this context, agricultural practices are shifting towards a more sustainable approach of using transgenic plants, plant growth-promoting bacteria, nano formulations, bio fertilizer, and bio control agents for enhancing crop productivity [4,5].

Seed priming technique is used for improving the vigor, establishment, and efficiency of seedlings in the fields. The early stage of seed germination requires suitable conditions; however, various biotic and abiotic factors hinder the process of germination. Seed biopriming using beneficial and eco-friendly biological agents could lead to improved physiology of seeds resulting into enhanced vigor of the seedlings [6]. Nitragin (Azotobacter, Azospirillum, Pseudomonas) inoculation seeds have 44% higher Leaf area index and 61% higher leaf chlorophyll index and 24% increase in ear dry weight [7]. *Moringa oleifera* has attained enormous attention because it is considered to be rich in a variety of natural plant growth regulators such as Zeatin which belongs to class of cytokinins and thus can be used as a source of cytokinins. It is also enriched with various macro-nutrients such as phosphorous and potassium along with micro-nutrients [8]. [9] suggested that *Lantana camara* aqueous extract could be used as a potential allelopathic substance for some weed bio-control.

2. MATERIALS AND METHODS

The experimental study was carried out during Rabi Season 2021-2022 at Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. The site is located at latitude 25.35° N, longitude 82.25° E and at an altitude of 78m above mean sea level. The soil is sandy loam in texture with moderate water holding capacity having pH varies from 7.0 to 8.0. With the view to find out suitable seed priming methods with bio fertilizers and botanicals on Sweet corn (SUGAR-75) the experiment was laid out in Randomized Block Design with 13 treatments replicated thrice. The experiment comprising 13 possible treatments viz., T_0- control, T_1-Azotobacter @ 10g for 12 hours, T_2- Azotobacter @ 20g for 12 hours, T_3-Azotobacter @ 30g for 12 hours, T_4-Azospirillum @ 10g for 12 hours, T_5-Azospirillum @ 20g for 12 hours, T_6-Azospirillum @ 30g for 12 hours, T_7- Moringa leaf extract @ 5% for 12 hours, T_8- Moringa leaf extract @ 10% for 12 hours, T_9- Moringa leaf extract @ 15% for 12 hours, T_{10}- Lantana leaf extract @ 5% for 12 hours, T_{11}- Lantana leaf extract @ 10% for 12 hours, T_{12}- Lantana leaf extract @ 15% for 12 hours. The above said treatments are prepared by using following methods:

For Seed priming with the Azotobacter and Azospirillum, 10% sugar solution carrier was used.

The sugar solution was prepared by adding 100 g sugar in 1 litre of water and boiled. Then After cooling the solution, maize seeds were put in the solution pot and taken out and the inoculants 10grams, 20grams, 30grams were thoroughly mixed with the maize seeds. These seeds were kept in shade before planting.

For the Preparation of Moringa leaf extract and lantana leaf extract the tender leaves of the respective plants were collected separately and dried beneath the shade the dried leaves were ground with electric mixer grinder or mortar and pestle. The extract was subjected to sieving repeatedly through muslin cloth and then exactly 50 grams and 100 grams and 150 grams leaf powder was taken using weighing balance and diluted with 100ml of pure water to prepare the required 5%,10%,15% leaf extract solutions for seed priming [10] The non primed seeds were formed the control.

3. RESULTS AND DISCUSSIONS

The results in Table 1, 2, 3 depicts that the mean performance of Different seed priming methods with biofertilizers and botanicals on growth, yield and yield attributing traits of Sweet corn (*Zea mays* L.).

3.1 Field Emergence Percentage at 4, 7 & 10 DAS

The maximum field emergence at 4 DAS was recorded in T6 – Azospirillum @ 30g (42.22) followed by T5 – Azospirillum @ 20g (41.11) whereas minimum field emergence at 4 DAS was recorded in Lantana leaf extract @ 15% (30).

The maximum field emergence percentage at 7 DAS was recorded in T6 – Azospirillum @ 30g (68.88) followed by T5 – Azospirillum @ 20g (67.77) whereas minimum field emergence at 7 DAS was recorded in Lantana leaf extract @ 15% (55.33).

The maximum field emergence percentage at 10 DAS was recorded in T6 – Azospirillum @ 30g (92.22) followed by T5 – Azospirillum @ 20g (91.11) whereas minimum field emergence at 10 DAS was recorded in Lantana leaf extract @ 15% (75.55).

Similar findings reported that 22.44% increase of maize sprouting was observed after a co-inoculation with Pseudomonas fluorescens and P. putida and a 20.39% increase after Azospirillum spp. Inoculation [11].

3.2 Plant Height at 30, 45, 60 & at Harvest DAS

The maximum plant height at 30 DAS was recorded in T6 – Azospirillum @ 30g (38.93) followed by T5 – Azospirillum @ 20g (37.77) whereas minimum plant height at 30 DAS was recorded in Lantana leaf extract @ 15% (31).

The maximum plant height at 45 DAS was recorded in T6 – Azospirillum @ 30g (108.67) followed by T5 – Azospirillum @ 20g (106.93) whereas minimum plant height at 45 DAS was recorded in Lantana leaf extract @ 15% (74.63).

The maximum plant height at 60 DAS was recorded in T6 – Azospirillum @ 30g (180.3) followed by T5 – Azospirillum @ 20g (177.5) whereas minimum plant height at 60 DAS was recorded in Lantana leaf extract @ 15% (131.73).

The maximum plant height at harvest was recorded in T6 – Azospirillum @ 30g (227.3) followed by T5 – Azospirillum @ 20g (215.56) whereas minimum plant height at harvest was recorded in Lantana leaf extract @ 15% (165.83).

Similar findings by Suthin raj et al. [12] evidently proved that the seed inoculation of Azospirillum will be appropriate on the growth and yield of hybrid maize.

3.3 Days to 50% Tasselling

The early days to 50% tasselling was recorded in T6 – Azospirillum @ 30g (53.33) followed by T5 – Azospirillum @ 20g (54) whereas late days to 50% tasselling was recorded in Lantana leaf extract @ 15% (53.33).

3.4 Days to 50% Silking

The early days to 50% silking was recorded in T6 – Azospirillum @ 30g (60.67) followed by T5 – Azospirillum @ 20g (62) whereas late days to 50% silking was recorded in Lantana leaf extract @ 15% (67.33).

3.5 Days to Maturity

The early days to maturity was recorded in T6 – Azospirillum @ 30g (81) Followed by T5 – Azospirillum @ 20g (82.33) whereas late days to maturity was recorded in Lantana leaf extract @ 15% (87).

Table 1. Mean performance of different seed priming methods for pre harvest characters in Sweet corn (*Zea mays* .L)

Symbols	Treatments	Field emergence %			Plant height (cm)				Days to 50% Tasselling	Days to 50% silking	Days to maturity
		4 DAS	7 DAS	10 DAS	30 DAS	45 DAS	60 DAS	At harvest DAS			
T_0	Control	33.33	60	83.33	32.6	85.03	137.86	174.56	59.33	66.33	85.67
T_1	Azotobacter	36.66	63.33	86.66	34.77	100.97	170.55	203.03	58	63.67	84.33
T_2	Azotobacter	37.77	64.44	87.77	35.77	102.87	172.35	204.86	57	64	83
T_3	Azotobacter	38.88	65.55	88.89	36.2	103.27	175.45	206.96	56	62.33	83.33
T_4	Azospirillum	40	66.66	90.00	36.2	104.23	176.33	209.8	55	62	82.67
T_5	Azospirillum	41.11	67.77	91.11	37.77	106.93	177.5	215.56	54	62	82.33
T_6	Azospirillum	42.22	68.88	92.22	38.93	108.67	180.3	227.3	53.33	60.67	81
T_7	Moringa leaf extract	34.44	61.11	84.44	34.43	95.77	158.5	183.06	58.33	65.33	86
T_8	Moringa leaf extract	36.66	63.33	86.66	34.83	101.27	165.9	187.83	58	64.67	85
T_9	Moringa leaf extract	38.88	66.66	90.00	35.63	101.83	169.53	195.16	57.33	65.67	85
T_{10}	Lantana leaf ex tract	32.22	58.88	82.22	32.93	81.53	137.3	174.73	59.33	66.67	86
T_{11}	Lantana leaf extract	31.11	55.55	76.66	32.4	81.47	133.06	172.06	60	67	86.33
T_{12}	Lantana leaf extract	30	53.33	75.55	31	74.63	131.73	165.83	60.33	67.33	87
	Minimum	30	53.33	75.55	31	74.63	131.73	165.83	53.33	60.67	81
	Maximum	42.22	67.77	91.11	38.93	108.67	180.3	227.3	60.33	67.33	87
	Mean	36.4	62.73	85.8	34.88	96.03	160.49	193.9	57.38	64.43	84.43
	CV	3.71	2.25	1.89	3.04	5.22	2.71	4.14	1.28	1.93	0.76
	S.Em	0.78	0.81	0.93	0.61	2.89	2.51	4.64	0.42	0.72	0.37
	CD 5%	2.27	2.38	2.73	1.78	8.45	7.33	13.55	1.24	2.101	1.09
	F-Test	S	S	S	S	S	S	S	S	S	S

Table 2. Mean performance of different seed priming methods for pre harvest characters in Sweet corn (*Zea mays*. L)

Symbols	Treatments	Cob Length (cm)	Cob girth(cm)	Number of Cobs / plant	Number ofRows / cob	Number of Grains / row	Seed index (g)
T_0	Control	13.3	11.53	1.26	14	32.6	20.56
T_1	Azotobacter	16.8	14.56	1.73	16.33	34.13	23.13
T_2	Azotobacter	17.46	14.8	1.8	16.66	34.53	24.03
T_3	Azotobacter	18.73	15.16	1.93	17	35.13	24.33
T_4	Azospirillum	19.66	15.3	2.06	17.33	35.46	24.86
T_5	Azospirillum	21.16	16.33	2.06	17.66	36.13	25.7
T_6	Azospirillum	21.73	17.46	2.13	18	37.33	25.8
T_7	Moringa leaf extract	15.26	14.53	1.46	15.67	33.26	23.03
T_8	Moringa leaf extract	16.8	14.66	1.53	16	33.8	23.63
T_9	Moringa leaf extract	16.76	14.63	1.66	16.67	33.86	23.86
T_{10}	Lantana leaf extract	13.03	11.63	1.2	14.33	32.73	19.73
T_{11}	Lantana leaf extract	12.9	11.13	1.13	13.66	32.46	19.06
T_{12}	Lantana leaf extract	12.33	10.3	1.06	13.33	31.86	18.73
	Minimum	12.33	10.3	1.06	13.33	31.86	18.73
	Maximum	21.73	17.46	2.13	18	37.33	25.8
	Mean	16.61	14	1.62	15.89	34.1	22.8
	C.V.	6.22	4.93	11.62	3.92	2.5	3.87
	S. Em	0.59	0.39	0.108	0.36	0.49	0.51
	C.D. 5%	1.74	1.16	0.31	1.05	1.44	1.49
	F- Test	S	S	S	S	S	S

Table 3. Mean performance of different seed priming methods for post harvest characters in Sweet corn (*Zea mays*. L)

Symbols	Treatments	Seed yield / plant (g)	Seed yield / plot (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T_0	Control	152.7	2.56	5.7	8.26	30.96
T_1	Azotobacter	189.46	4.83	8.33	13.13	36.77
T_2	Azotobacter	197.86	5.16	8.56	13.73	37.6
T_3	Azotobacter	205.2	5.3	8.7	14	37.69
T_4	Azospirillum	209.63	5.3	8.7	14	37.86
T_5	Azospirillum	214.63	5.63	8.86	14.5	38.84
T_6	Azospirillum	220.03	6.6	9.7	16.3	40.49
T_7	Moringa leaf extract	165.8	3.73	7.73	11.46	32.59
T_8	Moringa leaf extract	169.2	3.96	7.9	11.86	33.45
T_9	Moringa leaf extract	181.53	4.63	8.16	12.8	36.2
T_{10}	Lantana leaf extract	133.96	2.26	5.5	7.76	29.19
T_{11}	Lantana leaf extract	116.63	1.76	4.36	6.13	28.76
T_{12}	Lantana leaf extract	97.03	1.73	4.36	6.1	28.38
	Minimum	97.03	1.73	4.36	6.1	28.38
	Maximum	220.03	6.6	9.7	16.3	40.49
	Mean	173.36	4.11	7.43	11.54	34.52
	C.V.	3.9	9.85	8.56	8.54	4.08
	S. Em	3.91	0.23	0.36	0.56	0.81
	C.D. 5%	11.41	0.68	1.07	1.66	2.37
	F-Test	S	S	S	S	S

3.6 Cob Length

The maximum Cob length was recorded in T6 – Azospirillum @ 30g (21.73) followed by T5 – Azospirillum @ 20g (21.16) whereas minimum Cob length was recorded in Lantana leaf extract @ 15% (12.33)

Similar findings by Kharutso et al. [13] reported that the application of Azospirillum @ 20 g kg-1 seed has produced highest yield attributing characters like cobs weight, number of grain rows, length of cob, grain weight, grain yield, straw yield of maize.

3.7 Cob Girth

The maximum Cob girth was recorded in T6 – Azospirillum @ 30g (17.46) followed by T5 – Azospirillum @ 20g (16.33) whereas minimum Cob girth was recorded in Lantana leaf extract @ 15% (10.3).

3.8 Number of Cobs per Plant

The maximum Number of Cobs per plant was recorded in T6 – Azospirillum @ 30g (2.13) followed by T5 – Azospirillum @ 20g (2.06) whereas minimum Number of cobs per plant was recorded in Lantana leaf extract @ 15% (1.06).

3.9 Number of Rows per Cob

The maximum Number of rows per cob was recorded in T6 – Azospirillum @ 30g (18) followed by T5 – Azospirillum @ 20g (17.66) whereas minimum Number of rows per cob was recorded in Lantana leaf extract @ 15% (13.33).

3.10 Number of Grains per Row

The maximum Number of grains per row was recorded in T6 – Azospirillum @ 30g (37.33) followed by T5 – Azospirillum @ 20g (36.13) whereas minimum Number of grains per row was recorded in Lantana leaf extract @ 15% (31.86).

Similar findings reported that, the inoculation with Azospirillum increased the yield, number of grains in a cob row, ear length and number of grains per ear and grain yield up to 30 percent [14].

3.11 Seed Index

The maximum seed index was recorded in T6 – Azospirillum @ 30g (25.8) followed by T5 – Azospirillum @ 20g (25.7) whereas minimum seed index was recorded in Lantana leaf extract @ 15% (18.73).

3.12 Seed Yield per Plant

The maximum Seed yield per plant was recorded in T6 – Azospirillum @ 30g (220.03) followed by T5 – Azospirillum @ 20g (214.63) whereas minimum Seed yield per plant was recorded in Lantana leaf extract @ 15% (97.03).

3.13 Seed Yield per Plot

The maximum Seed yield per plot was recorded in T6 – Azospirillum @ 30g (6.6) followed by T5 – Azospirillum @ 20g (5.63) whereas minimum Seed yield per plot was recorded in Lantana leaf extract @ 15% (1.73).
Similar findings by Fernando et al. [15] observed that inoculation with A. brasilense increased ear length, grain yield and produced the highest profit in maize production.

3.14 Stover Yield

The maximum Stover yield per plot was recorded in T6 – Azospirillum @ 30g (9.7) followed by T5 – Azospirillum @ 20g (8.86) whereas minimum Stover yield was recorded in Lantana leaf extract @ 15% (4.36).

3.15 Biological Yield

The maximum Biological yield per plot was recorded in T6 – Azospirillum @ 30g (16.3) followed by T5 – Azospirillum @ 20g (14.5) whereas minimum Biological yield was recorded in Lantana leaf extract @ 15% (6.1).

Similar findings by Veresoglou et al. [16] concluded that the inoculation of cereal seeds with Azospirillum isolates has increased grain and forage yields 10-15% respectively.

3.16 Harvest Index

The maximum Harvest index was recorded in T6 – Azospirillum @ 30g (40.49) followed by T5 – Azospirillum @ 20g (38.84) whereas minimum Harvest index was recorded in Lantana leaf extract @ 15% (28.38).

4. CONCLUSION

On the basis of one season experimentation it is concluded that among all the seed priming methods, seed priming with T_6-Azospirillum @ 30g for 12 hours has shown significantly better performance followed by T_5- Azospirillum @ 20g for 12 hours in all the growth, yield and yield attributing traits. Therefore further investigation is needed to arrive at valid recommendations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ikramullah IHK, Muhammad N, Mohammad KNS, Sarhad J Agric. Heterotic effects or yield and protein content in white Quality Protein Maize. 2011;27(3):52-6.
2. Suthar M, Singh D, Nepalia V, Singh AK. Performance of sweet corn (*Zea mays*) varieties under varying fertility levels. Indian J Agron. 2014;59(1):168-70.
3. Kishore Varma P, Yamuna C, Suresh V, Ravi Teja M, Kumar VK, K. Potentiality of native Bacillus species in enhancing sesame seed germination and their antagonism against Macrophomina phaseolina under in vitro conditions. J Oilseeds Res. 2017;34(2):98-102.
4. Egamberdieva G, D, Lugtenberg B, Hagemann M. Symbiotic plant- microbe interactions: stress protection, plant growth promotion and biocontrol by Stenotrophomonas. In: Seckbach JMG, Grube M, editors Symbiosis and stress. Dordrecht/Heidelberg/London/New York: Springer. 2010:445-60.
5. Adesemoye AO, Egamberdieva D. Beneficial effects of plant growth promoting rhizobacteria on improved crop production: the prospects for developing economies. In: Maheshwari DK, editor Bacteria in agrobiology: crop productivity. Berlin, Heidelberg, Berg: Springer; 2013.
6. Ghassemi-Golezani K, Sheikhzadeh-Mosaddegh P, Valizadeh M. Effect of hydropriming duration and limited irrigation on field performance of chickpea. Res J Seed Sci. 2008;1(1):34-40.
7. Kouchebagh SB, Mirshekari B, Farahvash F. Improvement of corn yield by seed biofertilization and urea application. World Appl Sci J. 2012;16(9):1239-42.
8. Yasmeen A. Exploring the potential of Moringa (Moringa oleifera) leaf extract as natural plant growth enhancer. M Sc (Hons.) Agriculture. Faisalabad, Pakistan: Department of Agronomy Faculty of Agriculture, University of Agriculture; 2011.
9. Eman T, El-Kenany S, El-Darier M. Suppression effects of Lantana camara L. aqueous extracts on germination efficiency of Phalarisminor Retz.and Sorghum bicolor L. (Moench). J Taibah Univ Sci. 2013;7(2):64-71.
10. Gurjar MS, Ali S, Akhtar M, Singh KS. Efficacy of plant extracts in plant disease management. J Agric Sci. 2012;3:425-33.
11. Noumavo PA, Kochoni E, Didagbé YO, Adjanohoun A, Allagbé M, Sikirou R et al. Effect of different plant growth promoting rhizobacteria on maize seed germination and seedling development. Am J Plant Sci. 2013;04(5):1013-21.
12. Suthin Raj T, Sudhagar Rao GB, Rex Immanuel R, Pushpananthan KR. Effect of Panchagavya and combination of Biofertilizer and RDF on Hybrid maize (*Zea mays* L.). J Emerg Technol Innov Res. (JETIR). 2017;4(10).
13. Kharusto A, Singh AP, Longkumer LT, Singh PL, Singh PK. Effect of organic manures and Azospirillum on productivity and economics of maize (*Zea mays* L.). Asian. J Soil Sci. 2016; 11(1):213-6.
14. Davaran Hagh E, Rahimzadeh Khoii F, Valizadeh M, Khorshidi M. The role of Azospirillum lipoferumbacteria in sustainable production of maize. J Food Agric Environ. 2010;8:(3 & 4).
15. Fernando S. Galindo. Marcelo CM, Teixeira Filho. Salatiér Buzetti. Paulo: H. Pagliari., José, M.K. Santini., Cleiton, J. Alves., Marcio, M. Megda., Thiago, A. Nogueira R, Marcelo A, Arf O. Maize yield response to nitrogen rates and sources associated with Azospirillum brasilense. Agron J. 2019;111(4).

16. Veresoglou SD, Menexes G. Impact of inoculation with Azospirillum spp. on growth properties and seed yield of wheat: a meta-analysis of studies in the ISI Web of 20 Science from 1981 to 2008. Plant Soil. 2010;337(1-2):469-80.

© 2022 Narayana et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/89716