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Research Article

EVALUATION OF SEED COAT COMPOSITE USING TWO IMPORTANT CROP SPECIES *ZEA MAYS* L. AND *VIGNA MUNGO* L

[*]A.M. Ananda Kumar, U. Divyasree, P. Sathishkumar and R. Rakkimuthu

PG and Research Department of Botany, NGM College, Pollachi. Tamil Nadu, India

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ABSTRACT

The present study was designed to prepare a plant-based composite formulated and applied to seeds of *Vigna mungo* and *Zea mays* using both wet (extract-based) and dry (powder-based) coating methods to evaluate improvements in seed quality. Both coating methods recorded high germination percentages (>92%), with no negative effects on emergence. Significant enhancement in root and shoot growth was observed, particularly under T5 treatment, which produced maximum shoot (23.04 cm) and root (2.46 cm) lengths along with higher seedling biomass. Chlorophyll content increased up to 10.45 mg/g, indicating improved photosynthetic efficiency. Wet-method composites enhanced carbohydrate and protein content, while dry-method coatings similarly increased biochemical parameters in both crops. Phytochemical screening of the water extract confirmed the presence of glycosides, tannins, saponins, resins, steroids, and phenols, supporting the observed growth promotion. Overall, composite seed coatings effectively improved physical, physiological, and biochemical traits, enhancing early vigor and potential shelf life of seeds.

Keywords: Seed coating, Plant-based composite, Germination, Phytochemical constituents, Biochemical enhancement.

INTRODUCTION

Agriculture is an important sector of Indian subcontinent. Farmers are more important for any nation. For any crop, the time from harvesting to sowing and seedling establishment is very crucial as seeds are exposed to a wide range of environmental stresses biotic and abiotic stresses that can alter the quality aspects of seeds (Zinsmeister *et al.,* 2020, Zaheer *et al.,* 2021). The judicious use of crop specific physical, physiological, chemical and biological agents could off an attractive option for the development of sustainable good crop establishment, growth and productivity. Seed enhancements are post-harvest treatments that improve the performance of seeds such as germination, seedling growth and facilitate the delivery of seeds and other planting materials required at the sowing. Seed priming is one of the most important physiological seed enhancement methods. It is a hydration treatment of seeds which involves controlled imbibitions and induction of the pregerminated metabolism (activation), but radicle emergence is prevented (Kalaivani *et al.,*2010). The hydration treatment is withdrawn before desiccation tolerance of the seed is lost (Bose *et al.,* 2018). Seeds can be primed by soaking seeds in solutions up plemented with plant hormones or beneficial microorganisms for a specific period of time (Araujo *et al.,* 2016). The hydrated primed seeds can be reverted back to safe moisture content by drying for storage, distribution and planting. Seed priming is an easy and effective technique to get speedy and uniform emergence, high seedling vigour and higher yields of crops. This controlled hydration technique stimulates metabolic processes during early phase of germination before protrusion of radicle (Araújo *et al.,* 2016). Higher rate of germination of primed seeds primarily happens because of reduction in the lag time of imbibitions (Araújo *et al.*,2016), enzymatic activation, accumulation of germination enhancing metabolites metabolic repair during imbibition and osmotic adjustment. Seed quality plays an important role in crop production and lack of quality seed is one of the major hindrances in bridging the yield gap. Seed enhancement process involves pre-sowing hydration treatments or priming, hardening, coating technologies, seed conditioning and pre-germination but excludes treatments for control of seed borne pathogens. In magneto priming, magnetic field is used as a non-invasive

*Corresponding Author: Dr. A.M. Ananda Kumar, Assistant Professor, PG and Research Department of Botany, NGM College, Pollachi -642001, Coimbatore, Tamil Nadu, India. Email: anandhakumar@ngmc.org.

physical stimulant to improve seedling vigour and stress tolerance of the crop in the field. Nano priming can augment performance of seeds in many ways such as enhancing amylase activity, increasing soluble sugar content to support early seedlings growth, up-regulating the expression of aquaporin gene in germinating seeds, increased stress tolerance through lower ROS production, creation of nano pores for enhanced water uptake etc. The scope and relevance seed enhancement for sustainable agriculture with a special emphasis on recent advances in seed priming technologies. The factors that have an important contribution in the success of seed coating includes particle size distribution, porosity, water absorbing and holding capacity and extent of toxicity. So, it is desirable that precise distinguished coating agents and procedures can turn out to be relatively clear for improving seed quality and to obtain higher productivity (Ben-Jabeur *et al.,* 2021). In this connection with the above background present study was carried out to prepare a seed coating with plant powders and extracts as coatings on selected seeds. The seeds coated with various composites were called as seed priming. These primed seeds were evaluated for the various parameters including physical, chemical and physiological parameters in *Vigna mungo* and *Zea mays* on both wet and dry method application

MATERIALS AND METHODS

Selection of plants materials

The present work was planned to prepare the ecofriendly seed composite were prepared using herbs. The study may leads to improve the shelf life and seed quality. The following plant materials were selected to prepare the composite both in dry and wet method. *Ricinus communis, , Allium sativum , Zingiber officinale, Ocimum tenuiflorum, Justicia adhatoda Albizia amara* . The above plant materials were selected and used to prepare seed composite for seed priming to improve the shelf life and increase or decrease of the biochemicals produces of seeds. The above plant extracts were mixed and castor oil was added as binding materials to fix the composite on study seeds.

Collection of plant materials

The selected plant materials for the present study such as out of *Ricinus communis*, *Allium sativum, Zingiber officinale, Justicia adhatoda Ocimum tenuiflorum* and *Albizia amara* were collected from the daily bases. The collected plant materials were extracts, dried, powdered and stored containers.

Preparation of plant extracts and seed composite

The prepared plant extracts and plant dried powders were allowed to soaking the seeds at a definite they are tabulated as follows.

Survivability rate of the selected plants

The survivability and viability of the selected crop species was recorded and the observations were tabulated were 5 replications for each treatment. Each replications have 20 healthy seeds of *Vigna mungo, Zea mays* (monocot) seeds were cultured.

Table 1. Preparation of plant based composite.

S.No	Plants	T1	T2	T3	T4	T5
1	*Allium sativum*	10	10	5	5	10
2	*Zingiber officinale*	10	5	5	10	5
3	*Ocimum tenuiflorum*	5	5	10	5	5
4	*Capsicum annuum*	5	5	10	5	10
5	*Albizia amara*	5	5	7	10	5
6	*Justicia adhatoda*	5	10	3	5	5
	Total	40ml	40ml	40ml	40ml	40ml

Wet Method: (Asha Sinha and Shrvan kumar. 2019)

About Six plant extract (Ginger, Garlic, Amara, Chilly, Adhatoda, Tulasi) were prepared by macerating leaves/ roots in ratios weight/ volume (1:1) in distil sterilized water (DSW) and this extract is termed as standard extract (SE). Equal amount of plant parts in grams of from each plant were washed well and grinded in 200 ml of DSW by using grinder. The macerate was filtered through double layered cheese cloth and centrifuged at 3500 rpm for 20 minutes. The supernatant was filtered through Whatmann No. 42 filter papers. Treated seeds with botanicals on germination by using Seed germination towel method (Asha Sinha and Shrvan Kumar. 2019).

Dry Method (Asha Sinha and Shrvan kumar.2019)

Six plants are selected (Ginger, Garlic, Amara, Chilly, Adhatoda, Tulasi) were collected, shade, dried and mixed at a different ratios prepared by prepared composite in different five treatments. castor oil 10ml add five compositions. Each composition carries a total of 25gm at various combinations, five treatments are treated. Selected each treatment carries a total of 100 seeds of blackgram and maize seeds at varios combinations. *Zea mays* and *Vigna* *mungo* seeds are soaked in various combinations at more than 3 hours. Centrifuged at 3500 rpm for 20 minutes. The supernatant was filtered through Whatmann No.42 filter piper. This supernatant is pure stock (100%) (Sinha and Shrvan Kumar.2019).

Standard germination test (%)

One hundred seeds with five replications were tested in the laboratory according to the Rules of International Seed Testing Association (ISTA, 2011). The final count of germination was recorded on 20th day and the number of normal seedlings was counted and expressed as per cent germination. The germination percentage of Black gram is 80.9% and Maize is 90.2%. Physical parameters of seedling are collected on 20th DAS. (shoot and root length).

Measured average length in centimeters.

$$\text{Germination percentage} = \frac{\text{No.of seeds germinated} \times 100}{\text{Total no of seeds}}$$

Seedling fresh weight (g) (Sinha and Shrvan kumar,2019)

The seedling weight was taken after 15 DAS separately and the average weight of each replication were calculated.

Seedling dry weight (g) (Khatun *et al.,* 2010.)

The seedling dry weight was assessed and weighted after 2-3 days of drying.

Estimation of Growth and Morphological Parameters

The change in growth and morphological parameters caused due to foliar spray were observed and tabulated.

Plant height. (Priyanka Jagtap *et al.,* 2021 and Vinay Kumar and Prabhat Kumar Singh, 2021)

The height of the plants were measured from the base of the plant from the soil surface to the tip of the plant. The total length was expressed in cm.

Root length (Priyanka Jagtap *et al.,* 2021 and Vinay Kumar and Prabhat Kumar Singh, 2021)

The length of the root was usually determined the efficiency of the plant towards absorption of minerals from soil and it was measured from the base of the plant from the soil surface to the tip of the root and the total length is expressed in cm.

Preliminary phytochemical analysis

Test for flavonoids: (H_2SO_4 test)

About 0.5 ml of dilute ammonia solution, 0.5ml extract was added, following by addition of Con. sulphuric acid in side of test tube appearance of black with blue colour absence of flavonoid (Sumathy 2011).

Test for Tannin ($Fecl_3$ test)

About 0.5 ml of sample was mixed with 10ml of distilled water this was filtered and 0.1% ferric chloride reagent added to filtrate the indicates blue precipitate the presence of tannin (Ciulci,1994).

Test for saponin (Vigorous test)

About 0.5ml of extract was diluted with 20ml of distilled water and was agitated in graduated cylinder for 15minutes formation of Icm layer of showed the presence of saponine (Trease and Evans,1996).

Test for alkaloid (Mayer's reagent)

About 0.5ml of sample add drop by drop of Mayer's reagent the colour change in white precipitate is formed indicates the presence of alkaloid (Ogukwe et al.,2004).

Test for terpenoid (Salkowski test)

About 0.5ml of extract mixed with 2ml of chloroform and Con.H2SO4 to form layer a reddish brown colour formed indicates presence of terpenoid (Salkowski and Balish 1991).

Test for steroid

About 0.5ml of extract treated with 2ml of chloroform then added Con.H2SO4 formation of reddish brown colour ring. The presence of steroid (Ciulci,1994).

Estimation of chlorophyll content (Arnon, 1949)

The contents of chlorophyll a, b and total chlorophyll were estimated on the foliar treated and non-treated leaves and the contents were expressed as mg g^{-1} of fresh weight of each treatment.

Estimation of total carbohydrates (Yemm and Willis, 1954)

The total carbohydrate content of the treated leaf was estimated by anthrone method - 1 and expressed as mg g of fresh sample.

Estimation of Protein: (Bradford, 1948)

Soluble protein content of leaf was estimated by the Lowry method or Bradford method and expressed as mg g of fresh weight. The foliar treated leaves were taken for analysis. Estimation is usually carried out with buffers used for the enzyme assay.

RESULTS AND DISCUSSION

The plant-based composite was prepared to coat the seeds to increase the seed quality parameters. Two methods were employed to coat the seeds by means of wet and dry method. The wet method is by means of applying the seed coat through extracts the dry method the powder forms were used to coat the seeds. Both wet and dry method does not affect the germination study crops *Vigna mungo* and

Zea mays on the various combinations of treatment of composites. About more than 92% germination was recorded. T a b l e . 2 The physical parameters shoot and root length enhanced by 2 2.46 and 23.04cm respective on T5 treatment. The seedling weight was in 19.22gm whereas the *Vigna mungo* exhibited the 12.06cm and 13.05cm respectively. Successful coating of phosphours on plants improved early plant growth. Conventional broadcasting of fertilizers exhibited higher yield of crops. Table:4,5. The total chlorophyll content was increased 10.45mg/g of T5 treatment. The total chlorophyll content 7.53 mg/g at 7.53mg/g recorded in both *Vigna mungo* and *Zea mays*. Table :6,7 The wet method applications of composite showed the carbohydrate and protein production with 2.85mg/gm at T2 composite and 0.57 in T2 composite application in *Vigna mungo* . The 12 composite highly supports the biochemical pathway to producing carbohydrate and protein.Table:11 and 13. The carbohydrate and protein content was also estimated in dry method coating on *Zea mays* and *Vigna mungo* .The carbohydrate content was increased to 5.23mg/g , 0.64mg/g, 7.53 and 0.213 respectively in mg/g.T1 and T2 composite coated seeds.Table:10 and 13 Hence presence study clearly shows that the quality of seeds are improved to a considerable level. When compound with control both physical and biochemical parameters. Similarly, the results were found to be more relevant with Deepak et al., 2020 that seed priming with garlic reduce the infection rate and also enhances growth and yield of lentil. This may be due to the presence of Allicin.

Similar results were reported by Vigneshwari (2002) reported that seeds hardened with brasssinolide 0.1 ppm had positive effect on drought resistance which was evident from its increased physiological and biochemical aspects of finger millet seeds that resulted in increased yield of seed. Many studies on the improvement of growth and yield due to pre sowing seed hardening are documented (Solaimalai and Subbarmanu, 2004; Meek and Oosterhugs, 2005). The study was undertaken to evaluate the phytochemical constituents of the water extract to confirm the presence of bioactive compounds. The phytochemical test was conducted using third (T2) extract of wet treatment method. In third treatment the root length, shoot length, fresh weight, dry weight and the protein content of the plant were increased. The water extract of T3 showed the presence of glycosides, tannin, saponins, resin, steroids and phenols. The GC-MS Chromotogram of *M.paradisiaca* methanolic extract displayed 20 peaks, due to the presence of 20 compounds. The overall study exhibits seed composite coating has considerable role in the growth and development and increase plants shelf life of studied crop species. Hence t h e present study shows the shelf life of the plant increased and supports all levels when treated with various treatments.

Table 1. Preparation of plant-based composite.

S.No	Plants	T1	T2	T3	T4	T5
1	*Allium sativum*	10	10	5	5	10
2	*Zingiber officinale*	10	5	5	10	5
3	*Ocimum tenuiflorum*	5	5	10	5	5
4	*Capsicum annuum*	5	5	10	5	10
5	*Albizia amara*	5	5	7	10	5
6	*Justicia adhatoda*	5	10	3	5	5
7		40ml	40ml	40ml	40ml	40ml

Table 2. The germination percentage of *Zea mays* at various composite using wet method.

S. No	Composite treatments	No of plants	No.of plants germinated	Germination percentage
1	Control	100	98	98
2	W1T	100	96	96
3	W2T	100	97	97
4	W3T	100	92	92
5	W4T	100	98	98
6	W5T	100	95	95

Table 3. The germination percentage of *Vigna mungo* using wet method.

S. No	Tests	No.of . plants	No of plants germinated	Germination percentage
1	Control	100	98	98
2	W1T	100	96	96
3	W2T	100	94	94

4	W3T	100	92	92
5	W4T	100	98	98
6	W5T	100	95	95

Table 4. The variation in physical parameters of *Zea mays* treated with various composites using dry method.

S.No	Tests	Root length (cm)	Shoot length (cm)	Seedling weight (cm)
1	Control	21.56±1.11	21.85±1.37	13.565±0.72
2	D1T	22.16±1.34	22.08±1.32	13.33±0.45
3	D2T	21.72±1.86	21.11±1.80	12.97±0.74
4	D3T	21.99±1.43	21.84±1.86	12.05±0.05
5	D4T	21.11±2.56	21.11±2.56	19.62±0.85
6	D5T	23.04±0.77	22.46±1.90	19.22±0.85

Table 5. The variation in physical parameters of *Vigna mungo* treated with various composite using dry method.

S. No	Tests	Shoot length (cm)	Root length (cm)	Seedling weight (cm)
1	Control	11.98 ± 1.57	12.44 ± 1.48	3.04 ± 0.71
2	W1T	11.65 ± 1.37	11.52 ± 1.34	2.77 ± 0.63
3	W2T	9.58 ± 1.92	9.53 ± 1.75	3.17 ± 0.93
4	W3T	12.18 ± 1.41	12.06 ± 1.36	3 ± 0.60
5	W4T	10.81 ± 1.60	11.07 ± 1.64	3.18 ± 0.98
6	W5T	11.92 ± 1.41	13.05 ± 1.85	2.91 ± 0.72

Table 6. The total chlorophyll content of *Zea mays* treated with composite using wet method.

S. No	Tests	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})	Total Chlorophyll (mg g^{-1})
1	Control	2.66	7.60	10.27
2	W1T	2.57	7.50	10.08
3	W2T	2.76	7.36	10.12
4	W3T	3.02	7.14	10.17
5	W4T	2.64	7.59	10.23
6	W5T	2.75	7.70	10.45

Table 7. The total chlorophyll content of *Vigna mungo* treated with composite using wet method.

S.No	Tests	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})	Total Chlorophyll (mg g^{-1})
1	Control	1.67	4.68	6.35
2	W1T	1.78	4.58	6.36
3	W2T	1.98	4.89	6.88
4	W3T	1.86	4.44	6.30
5	W4T	1.81	5.24	7.06
6	W5T	1.83	5.70	7.53

Table 8. The total chlorophyll content of *Zea mays* treated with composite using dry method.

S. No	Tests	Chlorophyll a (mg g-1)	Chlorophyll b (mg g-1)	Total Chlorophyll (mg g-1)
1	Control	2.56	7.54	10.10
2	D1T	2.57	7.50	10.08
3	D2T	2.42	7.55	9.98
4	D3T	2.69	9.07	11.77
5	D4T	2.49	8.05	10.55
6	D5T	2.65	8.39	11.05

Table 9. The total chlorophyll content of *Vigna mungo* treated with composite using dry method.

S. No	Tests	Chlorophyll a (mg g^{-1})	Chlorophyll b (mg g^{-1})	Total Chlorophyll (mg g^{-1})
1	Control	1.72	4.73	6.46
2	D1T	1.78	4.58	6.37
3	D2T	1.94	4.89	6.84
4	D3T	1.82	4.43	6.26
5	D4T	1.81	5.24	7.06
6	D5T	1.83	5.70	7.53

Table 10. The Carbohydrate and Protein content of by *Zea mays* treated with various composites using wet method.

S.No	Tests	Carbohydrate (mg/gm)	Protein (mg/gm)
1	Control	4.45	0.060
2	W1T	4.03	0.057
3	W2T	2.85	0.052
4	W3T	2.47	0.049
5	W4T	1.89	0.042
6	W5T	1.93	0.034

Table 11. The Carbohydrate and Protein content of by *Vigna mungo* treated with various composites using wet method.

S. No	Tests	Carbohydrate (mg/gm)	Protein (mg/gm)
1	Control	7.14	1.24
2	W1T	6.57	0.15
3	W2T	6.57	0.08
4	W3T	6.43	0.07
5	W4T	6.34	0.06
6	W5T	6.18	0.03

Table 12. The Carbohydrate and Protein content of by *Zea mays* treated with various composites using dry method.

S.No	Tests	Carbohydrate (mg/gm)	Protein (mg/gm)
1	Control	4.62	0.06
2	D1T	5.23	0.04
3	D2T	4.06	0.06
4	D3T	3.43	0.04
5	D4T	2.26	0.03
6	D5T	2.21	0.02

Table 13. The Carbohydrate and Protein content of by *Vigna mungo* treated with various composites using dry method.

S.No	Tests	Carbohydrate (mg/gm)	Protein (mg/gm)
1	Control	7.20	1.45
2	D1T	7.53	0.16
3	D2T	7.71	0.21
4	D3T	6.67	0.09
5	D4T	6.54	0.08
6	D5T	6.24	0.03

Table 14. The qualitative phytochemical parameters for the composite.

S. No	Phytochemicals	Present/absent
1	Alkaloids	+
2	Flavanoids	+
3	Tanin	-
4	Phenol	+
5	Saponin	+
6	Resin	+
7	Terpenoids	-
8	Glycoside	-
9	Steroid	+
10	Quinones	-

\+ Present, - Absent

Table 15. GCMS analysis for the seed coating composite.

S. No	RT	Area %	Compound name	Molecular formula	Molecular weight	CAS#
1	4.153	0.12	Distannoxane, Hexabut yl-	$C_{24}H_{54}OSn_2$	596.105	00005 6-35-9 14
2		0.20	Oleanan-29-oic acid,3-(acetyloxy)	$C_{32}H_{50}O_4$	498.7	06316 6-97-2 10
3	4.709	0.11	Tris(3-acetyltetramsaeure)-gadolinium(iii)	$C_{27}H_{39}Gd$	520.8	10002 86-94-3 7
4	5.364	0.14	3-(2Bicyclo(2.2.1)hept-5-en-2-yl-2-oxo-ethyl)-3-hydroxy-3,1-dihydro-indol-2-one	$C_{17}H_{16}N_2O_3$	296.32	10003 00-35-9 58
5	5.531	0.43	2,4,6,8,9,10-Hexathiaadamantane,-benzyl-3,5,7-trimethyl-	$C_{10}H_{13}NS_6$	339.6	02140 4-64-8 45
6	5.653	0.73	.Pi.Cyclopentadienyl-dicarbonyl-ethylisonitril-trichlorgemyl-tungsten	$C_9H_8O_3W$-2	348.00	10002 88-00-1 18
7	5.998	0.12	2,4-Diamino-6,8-bis(3,4-dichlorophenyl)	$C_{18}H_{10}C_{14}N_6$	452.1	10002 51-74-1- 11
8	6.131	0.11	.pi.-cyclopentadinyl-dicarbonyl-e	$C_{14}H_{10}Fe_2O$	353.92 5	10002 88-00-1 56
9	22.329	0.87	Silane,1,4-pheny lenebis(trimethyl-N-methyl-1-adamantaneacetamide	$C_{12}H_{22}Si_2$	222.47	01318 3-70-5 72
10	21.607	1.10	Cyclotrisiloxane,hexa methyl 1,2-Bis benzene	$C_6H_{18}O_3Si_3$	222.46	01715 1-09-6 50
11	6.775	0.51	Chlorfenapyr carbonic acid	$C_{15}H_{11}BrCIF_3$ N_2O	407.61	12245 3-73-0 68
12	6.553	1.20	Cyclopentene, 1,2,3-trimethyl-	Cyclopentene, 1,2,3-trimethyl-	110.20	00047 3-91-6 76

13	6.875	0.21	2,4-Diamino-6,8-bis(dichlorophenyl)- 5,6-dihydro-8H-thiapyrimidine	$C_4H_6N_{40}$	126.12	1000251-74-1 11
14	7.364	0.11	Pentamethylcyclooentadienyl	$C_{10}H_{16}$	136.24	1000288-06-1 4
15	8.008	0.12	1,5-Methano-1H,7H,11H-Furo(3,4-g)	$C_{38}H_{44}O_8$	628.751	055452-65-8 10
16	8.253	0.11	4a,7a-Epoxy-5H-cyclopenta(a)cyclop	$C_{28}H_{40}O_{12}$	568.6	051906-02-6 91
17	8.342	8.80	Eugenol	$C_{10}H_{12}O_2$	164.20	000097-53-0 97
18	8.675	0.20	Preg-4-en-3-one,17.alpha.-hydroxy	$C_{21}H_{30}O3$	330.5	1000294-64-4 64
19	8.753	0.14	Propanamide,3-(3,4-dimethylphenyl sulfonyl)-	$C_{11}H_{15}NO_3S$	241.31	1000262-80-6 38
20	9.186	0.12	2-Buten-1-ol, 3-methyl-,acetate Benzene,[(methylenecyclopropyl) sulfonyl]	$BrCH_2CHCH_2CH_2OH$	280.34	078656-83-4 59

CONCLUSION

The above study clearly exhibits the quality of seeds are increased to a considerable both physically, physiologically and biochemically. Hence the present study shows the plant based composite coated on the seeds increased the physical parameter Shoot and Root length at variable levels. Most of the treatment found to be beneficial and quality of the seeds are also increased to a considerable level. The GC-MS evaluation on one of the composites was made to identify the chemical component of the composite.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

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