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Genetic effects of the biomedicines Gall MT (GMT) on advanced agronomy plant breeding horticulture environment socio-economy green science technology communication issues by preventing okra root knot and COVID-19

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ABSTRACT

Okra, the most 'Economically Important Number One Consumption Vegetable Crops' achieving the 'Nature's Gift to Human Disease Free Healthy Life', is hampered by different pathogens like nematodes, Meloidogyne incognita(Kofoid and White) Chitwood, causing the root knot (RK) disease which is easily controlled by different chemical pesticides, and the outbreak of Coronavirus disease 2019 (COVID-19) causing an emergent global pandemic and badly impacts on agronomy, plant breeding, horticulture, socio-economy, health, and environments. So there remains a need for developing effective biomedicine vaccines. The high diluted biomedicines Gall MT (GMT), prepared from Okra Root Galls (ORG), applied by foliar spray@ 20 ml (0.2 mg GMT)/plant, are highly effective against the root knot disease of okra, Abelmoschus esculentus (L.) Moench Cv. Ankur-40, with increasing plant growth and fruit production. The high diluted biomedicines GMT pretreatment is more effective than the GMT post treatment. The genetic effects of high diluted biomedicines GMT is thought to induce systemic acquired resistance response of the treated plants through the expression of Pathogenesis Related (PR) proteins genes (22 to 14 numbers), which are more or less similar molecular range (295 kD to 12.5 kD) of various coronavirus, and it will responsible for preventing RK and COVID-19 like virus diseases by inducing resistance or increasing immunity respectively, and improved on advanced in agronomy plant breeding agriculture horticulture environment socio-economy green science technology communication application issues with non-toxic effects on the environment, and it may help to new preventive treatments methods or drug development and research in the field of '21st Century COVID-19 like Pandemic, and Advances in Agronomy, Plant Breeding and Horticulture, and lead to optimal drug and vaccine targets in future.

Keywords: Genetic effects biomedicines Gall MT, Agronomy plant breeding horticulture, Okra

root knot, COVID-19.

INTRODUCTION

Okra is one the most economically important, commercially exploited, number one consumption in a variety of ways vegetable crops (Kochlar, 1986) which is the oldest widely cultivated oligo purpose, significantly contribute for nutritional, medicinal as well as industrial application (Chowdhury and Kumar, 2019), and used as traditional medicine, achieving the 'Nature's Gift to human disease free healthy life' multipurpose crop (Anonymous, 2015; Gemede et al., 2015; Sindhu and Puri, 2016), and India is achieved first in the world due to the fruits rich in vitamins, calcium, folic acid, carbohydrates, phosphorus, magnesium and potassium, iodine, mineral matters, and a good source of superior nutritional quality for human nutrition, and mature fruit and stems contain crude fiber, used in the paper industry and sugarcane industry (Anonymous, 2015). And okra has many potential health beneficial effects on human diseases like cardiovascular disease, type 2 diabetes, kidney diseases, skin infection, digestive diseases, some cancers, antioxidant, nootropic, eye, body immunity, blood pressure, obesity, asthma, constipation, heart disease, sexual health, and neurological disorders, etc. (Sindhu and Puri, 2016; Firdous, 2020; Savello et al., 1980). But okra has also been attractant to many pathogens, pests, and diseases infestation due to enrich source of nutrients, minerals, and fibers (Chowdhury and Kumar, 2019). Only the root knot nematode pathogens damage 10-40% of the total crop production annually, causing serious problems in our country and this indirectly affects our advanced agronomy plant breeding horticulture environment socio-economy green science technology communication issues, and agricultural economy also (Datta, 1999, 2003). The chemical pesticides have been extensively used by the farmers on the Indian soil for controlling different diseases (Datta, 1999, 2003). Though the pesticides are very much effective but it creates several problems in toxicity, pollution, cost effectiveness, environment friendliness, and biodiversity conservation (Datta, 1999, 2003). It is also reported that the pesticides block functional first known gene transfer between plants to insects or animals which detoxify the gene for neutralization of plant toxins, and the host's defenses mechanism is used for new pest control strategies also (Ledford, 2021; Jixing et al., 2021). Recently it is known from the thirty one countries across the globe that higher airborne pollen concentrations correlated with increased SARS-CoV-2 infection rates (Damialis et al., 2021).

On the other hands, the emergence of pandemic SARS-CoV-2 spread has bad impacts on the global socioeconomic especially among the households, adults, and children in low income countries, and the 77% of the households population have lost income, and food insecurity, and an inability to buy medicine and staple foods, etc. (Josephson et al., 2021). Food security is the most important and crucial aspect of sustainable development in the agricultural sector and the backbone of the economy, and the deciphering impact of the COVID-19 pandemic on food security, agriculture, massive consequences on health and livelihoods of developing countries (Workie et al., 2020). The COVID-19 not only reduced incomes, but also disrupted supply chains, chronic and acute hunger was on the rise due to various factors including conflict, socio-economic conditions, natural hazards, climate change, and pests like the locust outbreak compounding this crisis across 23 countries with the other zoonotic diseases remain a recurrent threat (World Bank, 2021). And the pandemic also led to crisis havoc on both the Indian and global agricultural system extensively, and the first quarter (April 2021 to June 2021), the immediate past quarter growth was estimated at 5.9% witnessing a decline of 2.5% point causing the impact on the Indian agricultural system *viz*., production, marketing, and consumption with the consumption pattern. The pandemic wreaked substantial physical, social, economic, and emotional havoc on all the stakeholders of the Indian agricultural system (Cariappa et al., 2021).

With the rapid rise of the highly increased transmissibility or virulence and dangerous resistance to vaccines strain, the delta coronavirus variant, scientists brace for impact in different countries for the importance of efficient public health measures and vaccination programs with the timely and science based global response, and they are confused to control the various variants of coronavirus 2 worldwide impacting on sustainable development goals, food systems, and on progress to the 'Advanced Agronomy Plant Breeding Horticulture Agricultural Systems' (Krause et al., 2021; Stephens et al., 2020; Wadman,2021). World Bank grants for global vaccination for the highest return investment and in the past time for them to pay up from the practical results "why so slows?" (Sandefur,2021), and the failure in final stage trials which might help the scientists for searching the actual cause to develop the future vaccines (Dolgin,2021).

Still now, after long lockdowns (near about one month) in Purba Bardhaman, West Bengal, India, on June 26, 2021, Table 1 shows that the total COVID-19 positive cases are 37393, the total number of discharge cases are 36577, the total number of COVID-19 death is 434, rate of recovery is 97.82% and rate of mortality is 1.16%. So it is an urgent need to find out by developing policy initiative, cheap, non-phytotoxic, and non-pollutant potential high diluted biomedicines for preventing both the pandemic crisis by improving the agriculture system with the findings and other new research to develop future support and treatments.

Table 1 (Part-I). Daily press briefing of the Purba Bardhaman District (Date: 26/06/2021, Up to 5.00 P.M. Daily) (Related to COVID-19).

Daily press briefing of the Purba Bardhaman District			
i)	Total no. of COVID Positive Patients found on the day of reporting*	:	31
ii)	Total no. of COVID positive patients**	:	37393
iii)	Total no. of active patients as on today***	:	382
iv)	Total no. of Discharged cases	:	36577
v)	Total no. of COVID death recorded	:	434
Quarantine Status			
vi)	Total no. of persons under institutional quarantine	:	0
vii)	Total no. of persons under home quarantine	:	0
viii)	Total no. of persons under quarantine from Maharashtra, Delhi, Gujarat, Tamil Nadu & M.P.	:	0
ix)	Total no. of persons under quarantine from other states of India	:	0
x)	Total no. of persons under relaxed from institutional quarantine	:	0
Testing Status			
xi)	Total no. of Samples collected up to 25.06.2021	:	276158
xii)	Total no. of Samples tested	:	275622
xiii)	Total no. of Positive cases	:	14682(+53 repeat +ve)
xiv)	Total no. of negative cases	:	259695(+1192 spillage/rejected)
Containment Zone Status			
xv)	Total no. of Containment Zone as on today	:	
xvi)	Total no. of Containment withdrawn	:	
Analysis of Positive Person Details: On date-Positive-			
xvii)	Total no. of Migrant (Other State+Other Dist. Of WB)	:	00
xviii)	No. of Persons in Safe House	:	07
xix)	No. of Persons in COVID Hospital	:	03
xx)	No. of Persons in Home Isolation	:	28
Analysis of COVID-19 +ve Cases			
xxi)	Rate of recovery# (Percentage)	:	97.82
xxii)	Rate of Mortality# (Percentage)	:	1.16
xxiii)	Antigen Test	:	1959
xxiv)	RT-PCR Test	:	705
xxv)	Test result within 24 Hrs	:	2046(RAT-1959 + RTPCR-87)

Table 1 (Part-II A). Distribution of COVID Positive cases found on 26/06/2021.

Name of the district	Number of cases	Name of the district	Number of cases	Name of the district	Number of cases	Name of the district	Number of cases	Name of the district	Number of cases
Aushgram-I	0	Galasi-II	0	Ketugram-I	1	Mongolkote	0	Burdwan Municipality	6
Aushgram-II	0	Jamalpur	3	Ketugram-II	0	Purbasthali-I	2	Dainhat Municipality	0
Bhatar	0	Kalna-I	5	Khandoghosh	2	Purbasthali-	1	Guskara	0

						II		Municipality	
Burdwan-I	0	Kalna-II	0	Manteswar	3	Raina-I	1	Kalna Municipality	2
Burdwan-II	2	Katwa-I	0	Memari-I	0	Raina-II	0	Katwa Municipality	0
Galasi-I	1	Katwa-II	0	Memari-II	1	Other District	1	Memari Municipality	0

Table 1 (Part-II B). Analysis on COVID-19 positive cases on 26/06/2021.

Analysis on COVID +Ve cases On 26/06/2021		*COVID positive as on today	**Total positive cases
Type	Symptomatic	03	2656
	Asymptomatic	28	34737
Total		31	37393
Contact Analysis	Primary contact	01	1500
	Travel from High Burden Dist. Of W.B.	00	217
	Travel from other state	00	435
	No Travel History	30	35241
Total		31	37393

So the different; plant extracts, pure compounds, homeopathy, allelopathy, phytomedicine, bio-agents, intercropped/multi cropped biomedicines, bio-medicinal meals, biomedicine vaccine, social vaccine, policy developed global vaccine, many models, etc. are applied to control against different diseases causing pathogens, control the plants and animal diseases causing pathogen (Datta,1999,2003,2006b,2019b,2019c,2019d,2020a,2020b,2020c,2020d,2020e,2020f,2020g, 2020h,2020i,2020j,2020k,2020l,22020m,2020n,2020o,2020p,2020q). But in all the cases it is not achieving potential success due to different causes.

Recently it has been observed that the animals and plants biomedicines; nematode MT (NMT) and root galls (RG) extract is the safe alternative method to control nematode pathogens by inducing their natural defense response of the host plants (Datta,1999,2003,2021k,2021l,2021m, 2021n,2021o; Datta et al., 1998a,1998b; Mukherjee et al., 2020). It is reported that the molecular antigens of SARS and MERS viruses have a wide range of immune cells that react to SARS-CoV-2 evolving to enhance viral fitness and immune evasion, which helps the development of potential vaccines for the delta variant triggering the new phase in the recent pandemic where WHO leader 'feeling that they're failing' expecting more social responsibility in the face of a global crisis (Cai et al., 2021; Yousaf and Hameed, 2021; Kupferschmidt and Wadman, 2021).

The present study exploited systematic signaling and induced natural defense in the host plants by applying high diluted biomedicines Gall MT (GMT), prepared from gall roots (GR), for the development of the most cost effective potential high diluted biomedicines or treatment methods or vaccines that will be policy initiative, non-toxic, non-pollutant, and side effect free preventing root knot diseases and the future pandemic COVID-19 global vaccines advancing in agronomy, plant breeding, horticulture, agriculture, and also to search the actual reasons of the genetic effects on the GMT biomedicines for preventing root-knot diseases.

MATERIALS AND METHODS

Place and preparation of high diluted biomedicines Gall MT (GMT)

The high diluted biomedicines Gall MT (GMT), prepared from the root galls (RG) of okra plants which were collected from roots of the okra plants, Abelmoschus esculentus (L.) Moench Cv. Ankur-40, grown in the experimental garden of the Department of Zoology, VisvaBharati University, Santiniketan – 731235, and they were washed with sterile tap water, homogenizer and extracted with 90% ethanol at room temperature (25 ± 2°C) for 15 days and centrifuged at @3500 rpm for 5 minutes, and then the gall extract (GE) supernatant was collected and allowed to evaporate at room temperature (25 ± 2°C) and the biomedicines residues were kept over anhydrous calcium chloride ($CaCl_2$) for dehydration and stored at 4°C. The crud GE biomedicines residue was mixed with sterile distilled water just before application on the test plants. The crude residue was diluted in 90% ethanol at 1mg/ml concentration and was prepared high diluted biomedicines, Gall MT

(Original Solution or Crude Extract i.e. Mother Tincture) (Datta and Datta, 2000; Datta et al., 1998a,1998b;Datta,1999,2006a,2010,2019a, 2020h, 2020l, 2020n,2020p, 2021b, 2021e,2021i, 2021j,2021m, 2021o, 2021p,2021q; Datta and Mukherjee, 2021; Sukul et al., 2001).

Pretreatments of high diluted biomedicines GMT test solution

For the preparation of high diluted test solution of the biomedicines GMT, were diluted (v/v)@1 ml drug/20 ml sterile distilled water (in the proportion of drug: water=1:20) respectively, and the high diluted biomedicines liquid control solution of both the drugs were diluted (v/v)@1 ml 90% ethanol/20 ml sterile distilled water (in the proportion of drug: water=1:20) respectively, and the control solution was prepared for comparison to the preparation of test solutions, and stored at 4oC for treatments media (Datta and Datta, 2000; Datta et al., 1998a,1998b;Datta,1999,2006a,2010,2019a, 2020h, 2020l, 2020n,2020p, 2021b, 2021e,2021i, 2021j,2021m, 2021o, 2021p,2021q; Datta and Mukherjee, 2021; Sukul et al., 2001).

Preparation of ultra-high diluted biomedicines Gall 30 to Gall 1000C

For the preparation of ultra-high diluted biomedicines liquid drugs, the high diluted GMT was diluted with 90% ethanol (1:100) proportionate in a round vial which was filled up to two thirds of its space, tightly crocked, and the vials were given 10 powerful downward strokes of the arm for mechanical agitation (succession), forming the 1st centesimal potency named Gall 1C. All the subsequent potencies were prepared by further diluting each potency with 90% ethanol in the same proportion (1:100) and the mixture was given 10 powerful downward strokes. In this way, different potencies of both the drugs; Gall 30C, Gall 200C, and Gall 1000C, were prepared respectively (Datta and Datta, 2000; Datta et al., 1998a,1998b;Datta, 1999,2006a, 2010,2019a,2020h,2020l,2020n,2020p, 2021b, 2021e,2021i, 2021j,2021m, 2021o, 2021p,2021q; Datta and Mukherjee, 2021; Sukul et al., 2001).

Pot test and inoculation

Aseptically germinated seeds of Abelmoschus esculentus (L.) Moench Cv. Ankur-40 was sown at the rate of one seed/pot (32 cm diam.) containing a mixture of clay soil and composted manure (2:1 v/v). The soil filled pots were treated with boiling water 5 (five) times. The pots were divided into four batches/groups; each numbering 10: (i) uninoculated untreated, (ii) inoculated untreated, (iii) GMT pretreated inoculated, and (iv) GMT posttreatment inoculated. All the treatments were done by foliar spray. The experiment was conducted outdoors at an ambient atmospheric temperature (27 ± 2°C) and relative humidity (75 ± 5%). Plants were inoculated at the 12 leaf stage (Day-25) with M. incognita (J2)@3425 ± 75 J2-larvae/plant (Datta and Datta, 2000; Datta et al., 1998a,1998b;Datta, 1999,2006a,2010,2019a,2020h,2020l,2020n,2020p,2021b,2021e,2021i,2021j,2021m,2021o, 2021p,2021q; Datta and Mukherjee, 2021; Sukul et al., 2001).

Treatments with high diluted biomedicines GMT

The high diluted biomedicines GMT test solutions were applied into the okra plants and sprayed on plants@20 ml/treated plants (received 0.02 mg/plant) three days before inoculation for pretreatments, and three days after inoculation with nematodes J2 for post treatment (Pre and Post inoculation treatments) respectively. Control okra plants were treated with an equal amount (20 ml) of control solutions prepared with sterile distilled water, and the plants were regularly watered in the morning and evening. During spraying, the soil surface underneath each plant was covered with a polythene sheet. Plants in both uninoculated untreated and inoculated untreated groups received a spray of an equal amount of control solutions. All treatments were done in hygienic conditions (Lowry et al., 1951; Chatterjee and Sukul, 1981; Datta et al., 1998a, 1998b; Datta, 1999, 2020l, 2020p, 2021b, 2021j, 2021k, 2021m, 2021p, 2021q). All the data were analyzed by ANOVA (Analysis of Variance). The experiment was repeated thrice. Data from the last experiment are reported here.

Okra root and nematode proteins scanning in densitometer

The okra root galls (ORG) and nematode female (NF) proteins separation was carried out by the method of Laemmli (1970) with the modifications as suggested by the LKB Instructional Manual (1986). A 10% separating gel and 5% stacking gel were used. The bands were scanned with a recording electrophoretic scanner (Biomidi, 96-300 densitometers). In Figure 1, the observation was recorded from the densitometer curve (Laemmli, 1970; Datta, 1999, 2020a, 2020b, 2020j).

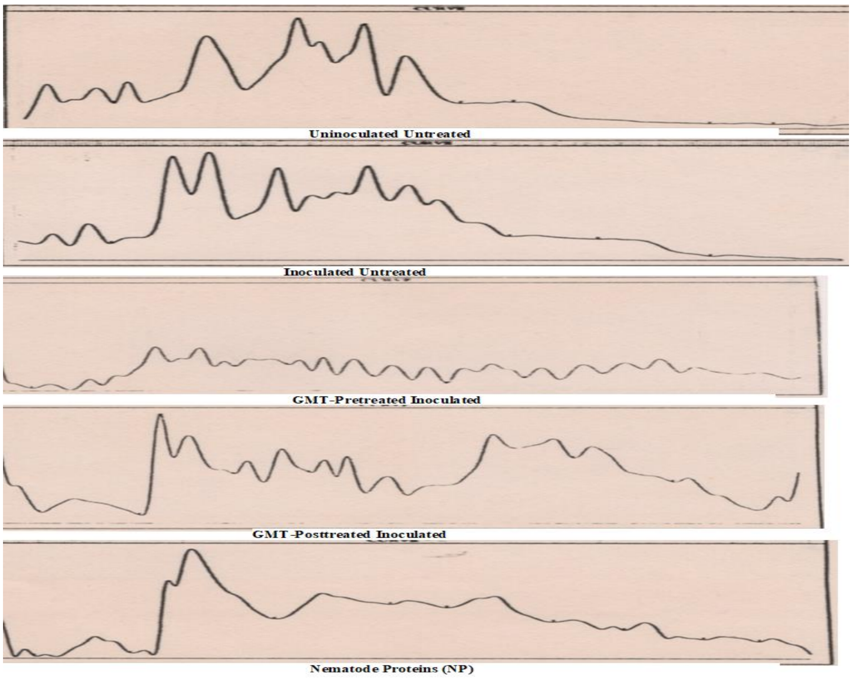

Figure 1 Densitometry tracings of root proteins of the GMT-treated on okra with nematode proteins resolved on acrylamide gel (SDS-PAGE).

Toxicity test

Biomedicines GMT has exposed directly for the study of toxic effect on nematode juveniles after 2 hours exposure periods at room temperature (20 ± 2 °C) (Datta, 1999, 2020l, 2020p, 2021b, 2021j, 2021k, 2021m, 2021p, 2021q).

Harvesting

All the plants were uprooted 53 days after the sowing of seeds. The following measure measurement was taken: biomass of shoot, root, and fruits, root gall number, nematode population in roots (2 g) and soil (200 g), the protein content of root and fruits. Proteins were estimated by the Folin-phenol method (Lowry et al., 1951; Chatterjee and Sukul, 1981). All the data were analyzed by analysis of variance (ANOVA). The experiment was repeated five times with similar results and the data from the third experiment were represented in Table 2.

Table 2. Effect of the GMT-pretreated and GMT-post treated on okra plants^{X} inoculated with root knot nematodes.

Treatments^{Y}	Fresh Biomass (g)^{X}			Number of fruits^{X}	Number of root galls^{X}	Nematode population^{X}		Protein^{X} content (%)		Number of total protein
	Shoot	Root	Fruits			Root (2 g)	Soil (200 g)	Root	Fruits	
I. Uninoculated untreated	198.22a^{Z} ± 10.04	27.78c ± 1.92	32.16a ± 10.02	19.38a ± 2.02	00			1.22c ± 0.22	2.25a ± 0.05	11
II. Inoculated untreated	76.01c ± 10.01	63.44a ± 6.42	13.27c ± 4.63	06.91c ± 2.03	402.89a ± 102.15	709a ± 26	63a ± 49	2.13a ± 0.01	1.14c ± 0.02	15
III. GMT-pretreated inoculated	194.99a ± 2.03	29.10c ± 1.02	31.53a ± 4.23	18.64a ± 2.02	15.01c ± 3.41	24c ± 18	78b ± 22	1.26c ± 0.24	2.19a ± 0.03	23
IV. GMT-post treated inoculated	168.24b ± 7.48	34.92b ± 2.04	26.02b ± 7.08	14.98b ± 3.04	58.65b ± 7.35	62b ± 12	89c ± 21	1.57b ± 0.19	1.77b ± 0.03	16

Note: 'X'-Mean of 10 replicates with S.E.
'Y'-Okra plants inoculated at 12-leaf stage (Day-25) with *M. incognita* juveniles (3425 ± 75 J_2/pot), pretreated with GMT at 8-leaf stage
(Day-22), and harvested 53 days after sowing of germinated seeds.
'Z'-Means carrying same letters in a column are not significantly different (P ≤ 0.05) by analysis of varience.

Advanced in agronomy plant breeding horticulture science technology issues

The farmers, administrators, institutions, students, communities, different scientist, academicians, clinicians, associations, teachers, staff, scholars, researchers, regulators, photographers, visitors, healthcare, media personnel, Burdwan Green Haunter and Students' Goal NGO, and different club and social organizations, organize street cornering, workshops, seminars, agriculture fair, health camp, campaign, aware, make the news, and publish in different journals emphasis on "Genetic effects of the biomedicines Gall MT (GMT) on advanced agronomy plant breeding horticulture environment socio-economy green science technology communication issues by preventing okra root knot and COVID-19" (Datta and Datta, 2000; Datta et al., 1998a,1998b;Datta,1999,2006a,2010,2019a, 2020h, 2020l, 2020n,2020p, 2021b, 2021e,2021i, 2021j,2021m, 2021o, 2021p,2021q; Datta and Mukherjee, 2021; Sukul et al., 2001).

RESULTS

Effect of high diluted biomedicines GMT treatment on Root Knot (RK)

The pre and post treated high diluted biomedicines GMT significantly (P ≤0.05 by ANOVA) increased plant growth in terms of the fresh biomass of shoot and fruits, as compared to the inoculated and untreated plants (Table 2). Root galls, nematode population in the root and soil, and root protein content were significantly (P ≤ 0.05 by ANOVA) reduced in both treated plants as compared to the untreated ones (Table 2). Protein content in green fruit was significantly reduced in inoculated untreated plants as compared to the uninoculated ones, and both the treatments with biomedicines GMT restored the condition to some extent (Table 2). GMT biomedicine pretreatment showed better plant growth and lesser intensity of root knot disease as compared to the GMT biomedicine post treatment (Table 2).

Effect of high diluted biomedicines GMT treatment on toxicity

The high diluted biomedicines GMT had not produced any direct toxic effect on nematode because no mortality occurs after 2 hours exposure period at 0.01 mg/0.1 ml concentration.

Genetic effects of Okra Root (OR) and nematodes female's proteins

Table 3 and Figure 1 shows the genetic effects (molecular weight (kD)) of Okra Root (OR) proteins for both pre and post treatments effects of high diluted biomedicines GMT treatments on M. incognita pathogens causing RK disease of the okra plants. An analysis of root proteins of all 4 groups and nematodes proteins by electrophoresis and densitometer scanning of all the test OR proteins show that all the high diluted biomedicines GMT pretreatments resulted in an increased number of proteins in the roots than post treatment and inoculated untreated groups; the highest number of root proteins in the high diluted biomedicines GMT pretreated inoculated group is 23, and next highest number of the root protein is 16 in the GMT post treatment inoculated group, and 15 in the inoculated untreated group and the lowest number of protein is 11 in the uninoculated untreated group respectively (Table 3 and Figure 1). The highest molecular weight of the OR protein is 295 kD and the lowest molecular weight of the OR protein genes is 11 kD. The lowest number of the new pathogenesis related protein genes (PR proteins) is 4 in the uninoculated untreated okra roots, and the highest number of the new PR proteins genes is 22 in the high diluted biomedicines GMT pretreated okra pretreatment group, and the same number i.e. 14 number of PR proteins genes is in both the high diluted biomedicines GMT post treatment and inoculated untreated treatment group respectively (Table 3 and Figure 1).

Table 3. Genetic effects of root proteins of the GMT-pretreated and GMT-post treated on okra with nematode proteins.

Treatments Groups (Except NP)	Total number of proteins	Molecular weight (kD) of pretreatment groups																							Total number of PR-proteins
		Serial number of proteins																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	

Uninoculated untreated	11	280	260	240	210	155	155	105	85	70	45	13	-	-	-	-	-	-	-	-	-	-	-	4
Inoculated untreated	15	270	240	200	170	145	188	98	90	77	65	58	46	37	27	17	-	-	-	-	-	-	-	14
GMT-pretreated inoculated	23	295	235	220	180	160	140	135	120	115	98	88	82	72	60	50	42	38	30	25	21	19	16.5	12.5	22
GMT-posttreated inoculated	16	260	210	150	135	120	110	95	80	72	60	50	37.5	28	23.5	16.5	11	-	-	-	-	-	-	-	14
Nematode Proteins (NP)	18	280	260	250	200	190	165	150	135	85	55	40	38	27	23	22	18	15	12	-	-	-	-	-	16
Note: '-' indicate no band and 'nematode protein' not included in the treatments group.																								

And the NF contained 18 proteins genes and the molecular weight of the NF proteins genes ranging from the lowest 12kD to the highest 280Kd, and the total number of the PR proteins genes of NF is 16 in comparison to the uninoculated untreated group (Table 3 and Figure 1).

DISCUSSION

On growth of Okra Plants (OP)

The recent study very clearly confirmed that the Okra Plants (OP) growth in terms of fresh biomass of shoot and fruits, and the number of fruits was higher than inoculated untreated groups in all the pre and post treatment groups of OP treated with the high diluted biomedicines GMT than inoculated untreated one, but reverse in the fresh biomass of roots of inoculated untreated (Datta et al., 1998 a, 1998b; Datta 1999, 2020l, 2020p, 2021b, 2021j, 2021k, 2021m, 2021p, 2021q).

On Root Knot (RK) diseases in Okra Plants (OP)

All the pre and post treatment groups of okra plants treated with high diluted biomedicines GMT decreased nematode infection in terms of root gall number and nematode population in root in comparison to inoculated untreated groups, and the population of nematode in the rhizospheric soil was the maximum with the group treated with high diluted biomedicines GMT, and minimum with the inoculated untreated group, due to potential high diluted effects of biomedicines, and it is also confirmed that the biomedicines GMT might induce synthesis of some antagonistic substance in the treated OP, which is proved from the inoculated untreated okra root galls (ORG) contained the highest protein content due to presence of a large number of nematodes (Chatterjee and Sukul, 1981; Datta et al., 1997; 1998 a, 1998b; Datta and Datta, 2000; Datta and Mukherjee,2021; Datta 1999, 2006a, 2006b, 2010, 2019a, 2020a, 2020b, 2020h, 2020j, 2020l, 2020n, 2020p, 2021b, 2021j, 2021k, 2021m, 2021p, 2021q).

On the toxicity

In the current study is also confirmed again that the high diluted biomedicines GMT had no direct toxic effects on nematodes juveniles, and okra plants, but it induced synthesis of some resistance substances in okra plants to M. incognita infection for preventing RK diseases in the OP, and for these reasons, all the treated group had significantly greater fresh biomass of shoot and fruits plants than inoculated untreated one (Datta et al., 1998 a, 1998b; Datta 1999, 2020l, 2020p, 2021b, 2021j, 2021k, 2021m, 2021p, 2021q).

On defense mechanisms

The present experiment once more confirmed that the high diluted biomedicines GMT act as a really effective preventive biomedicines against plant diseases because of their defense resistance, and it's reported that the lectins accumulated in galled regions of the OR infected with the RK disease (Das et al., 1989). It's already reported that the various crop plants will be induced by acquiring systemic resistance for the localized virus infection or non-pathogenic, and pathogenic microorganisms or their culture filtrates or gas or salicylic acid, etc. protects plants from the numerous pathogens attack, by working systemically (Ross, 1961; Descalzo et al., 1990; Kuc' and Strobel, 1992; Merra et al., 1994; Kiessig and Malamy, 1994; Kiessig et al., 2000; Schneider et al., 1996; Manuch-Mani and Metraux, 1998; Nandi et al., 2002, 2003; Mukherjee et al., 2020; Datta et al., 1998a, 1998b; Datta 1999, 2020l, 2020p, 2021b, 2021j, 2021k, 2021m, 2021p, 2021q).

On genetic effects of Okra Roots (OR) Pathogenesis Related (PR) proteinsgenes

It is reported that the M. incognita is known to share common antigens with its host plants (McClure et al., 1973 and Iqbal et al., 2020) informed that the attempt to 'Silence Genes' of the root knot nematode, M. incognita results in diverse responses including increase and no change in expression of some genes. So in the all the treated plant's roots show that the high diluted biomedicines GMT pretreatments resulted in an increased number of proteins genes in the root than post-treatment and inoculated untreated okra plants groups; the highest number of PR proteins genes in the high diluted biomedicines GMT pretreated group is 23, and the next highest number of the PR protein gene is 16 in the post treated GMT inoculated group, and 15 in the inoculated untreated group, and the lowest number of protein is 11 in the uninoculated untreated group respectively, which proved that during infection with the nematode, host plants showed minimal defense responses to the nematode because of this antigenic similarity, and the different PR proteins genes of the okra root proteins ranging from 295kD (the highest molecular weight protein) to 11kD (the lowest molecular weight protein) of the OR protein. And both the high diluted treated biomedicines; GMT stimulate the synthesis of numerous different PR proteins antigens genes that must induce defense responses in which the nematodes fail to survive, and it is also proved from the plant nematode interaction, newly synthesized PR proteins genes have been found in potato plants infected with the potato cyst nematodes Globodera pallida and G. rostochiensis (Hammond-Kosack et al.,1989; Rahimi et al.,1993, 1996). It is also reported that salicylic acid (SA) increases resistance in plants against RK diseases by inducing expression and accumulation of pathogenesis related-I protein (14 kD, PR-I) in the sprayed plant root and leaves, and it sprays enhances PAL higher activity in infected roots (Nandi et al.,2002,2003; Mukherjee et al.,2020; Datta,1999,2020j,2020n,2021p,2021q; Iqbal et al., 2020).

On genetic effects of NF Pathogenesis Related (PR) proteins genes

The 16 PR proteins genes out of total 18 proteins genes of NF of M. incognita in comparison to the uninoculated untreated group, and the molecular weight of the nematode proteins genes ranging from lowest 12kD to highest 280kD, proved the potential efficacy of the high diluted biomedicines GMT use as an effective stimulus for the expression of these various new 16 defense related PR proteins genes might be provided resistance to nematode infection in okra plants due to nematodes present in the gall roots also, and it can be preventing pathogenesis in patients with COVID-19 due to more or less proteins genes range (240kD to 26kD) in different bovine and human coronavirus structural proteins which send genetic information, and the SARS-CoV-2 genes may integrate with human DNA to code the essential nonstructural proteins like an RNA-polymerase also, and the nematode proteins genes slip into human chromosomes and the diverse immunological factors on viral dissemination, immunotherapeutic options, and inflammatory responses, and need molecular characterization and understanding of the human coronavirus life cycle, structural and functional properties of SARS-CoV-2 spike protein for potential antivirus drug development, and analysis of therapeutic targets for SARS-CoV-2 and discovery of potential drugs by computational methods, and genomic characterization and epidemiology of 2019 or genomic epidemiology has come of age during this pandemic affording to track SARS-CoV-2 sequences helped identify worrying variants, with implications for virus origins and receptor binding also, for preventing the COVID-19,— but researchers are blind to emerging mutations in some regions, and so it is thought, "the next pandemic by transforming food systems for affordable healthy diets" (Rabaan et al., 2021; Cohen, 2021a,2021b,2021c; Datta,1999,2003,2021k,2021l,2021m,2021n,2021o; Datta et al., 1998a,1998b; Mukherjee et al., 2020). Recently it may help from the report that cellular senescence (SnC) contributes to inflammation, multiple chronic diseases, and age related dysfunction, and the SnC become hyper inflammatory in response to Pathogen Associated Molecular Patterns (PAMPs), including SARS-CoV-2 Spike protein-1, increasing expression of viral entry proteins and reducing anti-viral gene expression in non SnCs through a paracrine mechanism (Camell et al., 2021).

On genetic effects of okra root galls Pathogenesis Related (PR) proteins genes

In the GMT pretreated okra root galls (ORG), the 22 PR proteins genes out of total 23 proteins genes of NF proteins genes of M. incognita in comparison to the uninoculated untreated okra plant group, and the molecular weight of the ORGs proteins genes ranging from lowest 12.5kD to highest 295kD, proved the potential efficacy of the pretreatment high diluted biomedicines GMT act as an effective stimulus for the expression of these many new 22 defense related PR proteins genes might be provided resistance to nematode infection in okra plant. And the genetic effects of high diluted biomedicines GMT is thought to induce systemic acquired resistance response of both the pre and post treated plants through the expression of pathogenesis related (PR) proteins genes (22 to 14 numbers), which are more or less similar molecular range (295kD to 11kD) of various coronavirus, and it will responsible for preventing RK and COVID 19 like virus diseases by inducing resistance or increasing immunity respectively, and improved on advanced in agronomy plant breeding agriculture horticulture environment socio-economy green science technology communication application issues with non-toxic effects on the environment(Rabaan et al., 2021; Camell et al., 2021; Cohen, 2021a, 2021b,2021c;Datta,1999, 2003, 2021k, 2021l, 2021m, 2021n, 2021o; Datta et al., 1998a,1998b; Mukherjee et al., 2020).

FUTURE RESEARCH

The gall protein could be induced the production of new defense related PR genes in the test plants and might be confirmed, and in near future, synthetic production of the RG proteins would be the potential cost effective personalized biomedicine OR social vaccine OR vaccine against coronavirus 2 like pandemic diseases by increasing immunity, and helping policy initiative clinical research in all areas in the field of advanced agronomy plant breeding horticulture agricultural, aquatic sciences, environment, socio-economy, and green science technology communication issues by preventing okra root knot and COVID-19 also. Thus, RG proteins will serve as very effective biomedicines that would be the most effective cheapest, non-phytotoxic, non-pollutant, conserve our biodiversity, and this vaccine might be the most effective against the delta variant of coronavirus, and scholars that give good scope for new development and future research in various fields of medical pathology (Martin, 2021; Datta,1999,2003,2021k,2021l, 2021m, 2021n,2021o; Datta et al., 1998a,1998b; Mukherjee et al., 2020).

CONCLUSION

The high diluted biomedicines Gall MT (GMT) pretreatment is more effective than the GMT posttreatment. The genetic effects of high diluted biomedicines GMT is thought to induce systemic acquired resistance response of the treated plants through the expression of pathogenesis related (PR) proteins genes (22 to 14 numbers), which are more or less similar molecular range (295 kD to 12.5kD) of various coronavirus, and it will responsible for preventing RK and COVID-19 like virus diseases by inducing resistance or increasing immunity respectively, and improved on advanced in agronomy plant breeding agriculture horticulture environment socio-economy green science technology communication application issues with non-toxic effects on the environment, and it may help to new preventive treatments methods or drug development and research in the field of '21st Century COVID-19 like Pandemic, and Advances in Agronomy, Plant Breeding and Horticulture, and lead to optimal drug and vaccine targets in future also.

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CONFLICT OF INTEREST

The author has declared no conflict of interest.

REFERENCES

Anonymous (2015). Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture, Government of India, Gurgaon.

Cai Y, Zhang J, Xiao T, Lavine CL, Rawson S, Peng H (2021). Structural basis for enhanced infectivity and immune evasion of SARS-CoV-2 variants. bioRxiv.

Camell CD, Yousefzadeh MJ, Zhu V, Prata LGPL, Huggins MA, Pierson M, Zhang L, O'Kelly RD, Pirtskhalava T, Xun P, Ejima K. (2021) Senolytics reduce coronavirus-related mortality in old mice. Sci. eabe4832:1-20.

Cariappa AGA, Acharya KK, Adhav CA, Sendhil R, Ramasundaram P (2021). Impact of COVID-19 on the Indian agricultural system: A 10-point strategy for post-pandemic recovery. Outlook. Agric. 50(1):26–33.

Chatterjee A, Sukul NC (1981). Total protein of galled roots as an index of root-knot nematode infestation of lady finger plants. Phytopathol. 71:372-274.

Chowdhury S, Kumar S (2019) Okra Breeding: Recent approaches and constraints. Anna. Biol. 35(1):55-60.

Cohen J (2021a) For WHO leader, a 'feeling that we're failing'. Sci.372(6549):1376-1377.

Cohen J (2021b) Do coronavirus genes slip into human chromosomes? Sci. 372(6543):674-675.

Cohen J (2021c). Further evidence supports controversial claim that SARS-CoV-2 genes can integrate with human DNA. Sci.

Das S, Sukul NC, Mitra D, Sarkar H (1989). Distribution of lectin in nematode infested and uninfested roots of *Hibiscus esculentus.* Nematol. Medit. 17:123-125.

Damialis A, Gilles S, Sofiev M, Sofieva V, Kolek F, Bayr D (2021) Higher airborne pollen concentrations correlated with increased SARS-CoV-2 infection rates, as evidenced from 31 countries across the globe. PNAS. 118(12):e2019034118.

Datta SC, Datta R (2000). Defence resistance of okra against root-knot disease by bio-nematicides. Pro. Zool. Soc. Cal. Univ. W.B. Ind. 59(2):75-82.

Datta SC, Mukherjee R (2021). High-diluted-potential-internal-biomedicines Zingiber officinale extract prevent 21st-century pandemic: Enriched drugs health socio-economy! Unit. J. Inter. Med. V1(3):1-4.

Datta SC, Sinhababu SP, Banerjee N, Ghosh K, Sukul NC (1998 a). *Meloidogyne incognita* extract reduces *M. incognita* infestation of tomato. Ind. J. Nematol. 28(1):1-5.

Datta SC, Datta R., Sinhababu SP, Sukul NC (1998 b). Acaciasides and root-knot nematode extract suppress *Meloidogyne incognita* infection in lady's finger plants. Proceeding of National seminar on Environmental Biology, Visva-Bharati, Santiniketan, West Bengal, India, April 03-05, 1998, (Ed.) by Aditya,A.K. & Haidar, P. 205-209.

Datta SC, Sinhababu SP, Sukul NC (1997). Improved growth of silkworms from effective treatment of mulberry diseases by *Accacia auriculiformis* extract. Sericol. 37(4):707-712.

Datta SC (1999). Bio-nematicides in the control of root-knot nematode. Ph.D. thesis, Department of Zoology, VisvaBharati, Santiniketan-731235, West Bengal, India.

Datta SC (2003). Plant parasitic nematodes - an agricultural problem and its solutions. The Visva-Bharati Q. 11:89-100.

Datta SC (2006a). Effects of Cina on root-knot disease of mulberry. Homeopath. 95:98-102.

Datta SC (2006b). Possible use of amaranth as catch crop for root-knot nematodes intercropped with okra. Phytomorphol. 56:113-116.

Datta SC (2010). The Role of Cina in the field of enriched sericulture. Hpath. Ezine.

Datta SC (2019a), Enriched Sericulture from Effective Treatment of Mulberry Diseases by Homeopathic Medicines. Adv. Biochem. Biotechnol. 7:084.

Datta SC (2019b). Improved Environment by Identification of More Susceptible Plant Between Cowpea and Mulberry for Root-Knot Disease. Op. Acc. J. Environ. Soil Sci. 2(5):242-245.

Datta SC (2019c). Enriched school health for the effective healthcare bio-activity of barn owls. Res. Rev. Heal. Car. Op. Acc. J. 3(3), 269-275.

Datta SC (2019d). Enriched school environment for the effective bio-activity of barn owls. Int. j. Hor. Agric. Food scie. 3(3):119-126.

Datta SC (2020a). Enriched science and technology communication economy in agriculture by use of acacia sides as potential bio-agents against various pathogens. Adv. Agric. Hort. Ento. 2:1-13.

Datta SC (2020b). *Acacia auriculiformis* extract synthesis PR-Proteins developed potential biomedicines-vaccine against okra-diseases and COVID-19: Improved science technology communications bio-economy applications. Int. J. 8(10):249-270.

Datta SC (2020c). Cina-pretreatments act as potential-biomedicine-vaccine against covid-19 and okra-plant-diseases: Synthesis PR-Proteins increased-immunity improved biomedicines-economy applications science-technology-communications. Int. J. Ayur. 5(12):05-26.

Datta SC (2020d). Okra maybe potential cost-effective personalized-biomedicines social-vaccine against COVID-19: Improved immunity food-security green-economy science-and-technology-communication applications. Innov. J. Med. Sciences 4(2):5-20.

Datta SC (2020e). Intercropped cowpea maybe use as biomedicine improved immunity against COVID-19: enriching science and technology communication applications food security economy. Diagn. Therap. Comple. Tradit. Med.

2020(1):35-48.
Datta SC (2020f). Weeds-vegetables and fruits act as potential biomedicines against covid-19: enriched agriculture biodiversity socio-economy science technology communications by controlling plants diseases. J. Exp. Bio. Agric. Sci.
Datta SC (2020g). Biomedicines-Aakashmini Cost-Effective COVID-19 vaccine: Reduced plant-diseases enriched science technology communications socio-economy bio-applications. Glob. J. Biosci. biotech. 9(4):127-144.
Datta SC (2020h). Discovery of COVID-19 vaccine by using Acaciades as a phytomedicine improving science and technology communication applications-ideas. J. Biogen. Sci. Res. 2(1):1-30.
Datta SC (2020i). Improved Science and Technology Communications: Barn Owl Act As Social Vaccine Against COVID-19. Int. J. Lat. Res. Sci. Technol. 9(3):6-13.
Datta SC (2020j). Potential policy-developed global-COVID-19-vaccine: Enriched medical sciences and technology green-socio-economy. Cross Cur. Int. J. Med. Biosci. 2(10):143-154.
Datta SC (2020k). Improved midday meal by using cowpea as eco-friendly crop controlling root-knot forming global, green, growth and green economy. Int. J. Adv. Res.
Datta SC (2020l). Biomedicines-Cina against COVID-19: Controlled Plant Diseases Enriched Science and Technology Communication Green Economy. The Int. J. Res. 8(9):234-255.
Datta SC (2020m). NGO act as potential-policy-developer social-vaccine-COVID-19 epidemic-model until discovery-of-medical-vaccine: Achieved green-socio-economic welfare science technology innovations. Arch. Commun. Med. Pub. Heal. 6(2):225-232.
Datta SC (2020n). Biological and biosystems engineering barn owl controlled COVID-19: engineering bio-mechanical biomedical science technology communication enriched agriculture environment. Int. J. Engineer. Sci. Inv.
Datta SC (2020o). Cina-pretreatments act as potential-biomedicine-vaccine against covid-19 and okra-plant-diseases: Synthesis PR-Proteins increased-immunity improved biomedicines-economy applications science-technology-communications. Int. J. Ayurv. 5(12):05-26.
Datta SC (2020p). Artificial-nest rainwater-harvesting with fishery and floating-or-rooftop-gardening act as 21st century civil-engineering COVID-19 epidemic-model: Improved biodiversity agriculture socio-economic environmental-sciences technology-communication. J. Civil Engine. Environ. Sci. 6(2):022-036.
Datta SC (2020q). Homeopathic medicines Aakashmoni will be the best vaccine against covid-19: Enriching agriculture science and technology communication mechanism application issues!" Int. J. Res. 8(11):333-361.
Datta SC (2021a). Weed-plant act as vaccine against plant-and-covid-19 diseases: Enriched-agriculture-health-development socio-economy sciences-technology-communication-application. Int. J. Pharma. Sci. Clinic. Res. 1(1):1-17.
Datta SC (2021b). Immediate apply cost-effective easily preparable-available 21st century potential–ayurvedic-herbal-integrative-medicine-vaccine of COVID-19: Achieved agriculture healthcare-socio-economy science technology communication mechanism! Int. J. Res. 9(1):227–247.
Datta SC (2021c). Only environmental science act as natural bio-medicine preventive epidemic model of 21st century pandemic diseases. Environ Sci. Ind. J. 17(1):e177.
Datta SC (2021d). Students act as 21st century preventive-pandemic-covid-19 model: Improved advance-clinical-toxicology biomedicine green-socio-economy science-technology-innovations. Adv. Cl. Toxicol. 6(1): 000204.
Datta SC (2021e). Immediate apply cost-effective easily preparable-available 21st century potential–ayurvedic-herbal-integrative-medicine-vaccine of COVID-19: Achieved agriculture healthcare-socio-economy science technology communication mechanism! Int. J. Res. 2021e; 9(1):227–247.
Datta SC (2021f). High-diluted pharmacological-potential biomedicines prevent 21st century COVID-19 like pandemic: Improved drugs-research biodiversity agriculture socio-economy. Edit. Am. J. Phar. 4(1):1031.
Datta SC (2021g). Amaranth plant protects climate-health-development socio-economy sciences-technology-communication: Act as potential biomedicine-vaccine against plant and 21st century-epidemic COVID-19 Diseases. Exp. Opin. Env. Biol. 10:1.
Datta SC (2021h). 21st century preventive non-medicinal-covid-19-students-model: Improved med life clinics sciences technology communication. Med. Life Clin. 3(1):1029.
Datta SC (2021i). Dinna Nath Das middle english school and dispensary act as a model: The 21st-century-Coronavirus-2 resistance futuristic common ecofriendly complex green digital school health ecosystem by bio medicine vaccine nationalism equity passport. SunText Rev. Arts Social Sci. 2(1),117-224.

Datta SC (2021j). Sustainable reopening of school preventing reinfection-coronavirus 2 in new-normal by vaccine nationalism equity passport with ginger drinks biomedicinal midday meals! Int. J. Res. 9(5):165-170.
Datta SC (2021k). Emergency Application of Ultra-High-Diluted-Biomedicines as Vaccine-Nationalism-Equity-Passport Preventing-Coronavirus-2: Developed Medical Health Clinical Research Science Technology Communication. Medico. Res. Chron. 8(2):132-135.
Datta SC (2021l) Vaccine-Passport Bio-Medicinal-Meals Prevent Reinfection-Coronavirus-2: Improved Global-Health-Clinical-Drug-Discovery-Education-Research Socio-Economy-Science-Technology-Communication-Application Aditum. J. Clin. Biomed. Res. 2(3):1-7.
Datta SC (2021m). Nematode Extract and Acaciasides Use as Preventive Biomedicines Against Plant Diseases: Improved Earth-Environmental-Health-Research Science-Technology-Communication and May be Controlled 21st-Century Pandemic Diseases! Eart. Envi. Scie. Res. Rev. 4:55-60.
Datta SC (2021n). Animal-Biomedicine Controls Root-Knot-Disease in Lentil-Callus-Culture: Enriched Advanced-Clinical-Toxicology Socio-Economy Science-Technology-Communication by Preventing 21st–Century-COVID-19-Like-Pandemic-Diseases. Adv Clinic Toxicol. 6(2):000214.
Datta SC (2021o). Biomedicines Suppress Root-knot Disease of Tomato and Coronavirus-Like-Pandemic-Diseases: Improved Agriculture Green-Socio-Economy Aquatic-Science-Technology-Communication! J. Agric. Aqua. Science 1:08-10.
Datta SC (2021p). Genetic Basis of Nematode Extract May Be Preventive-Biomedicines Against Coronovirus-2 by Controlling Root-Knot-Disease of Cowpea-Root-Callus: Enriched Agriculture Clinical Medical-Science-Technology-Communication! Glob. J. Cl. Med. C. Rep. 1(1):010-018.
Datta SC (2021q). Potential-Biomedicines Against COVID-19: Enriched Food-Security Sustainability Agriculture-Biodiversity Socio-Economy Science-Technology-Communication-Application-Issues by Preventing Root-Callus-and Plant-Diseases. Adv. Food. Secur. Sustain. 6.
Descalzo RC, Rahe JE, Mauza B (1990). Comparative efficacy of induced resistance for selected diseases of greenhouse cucumber. Can. J. Pl. Path. 12(1):16-24.
Dolgin E (2021). CureVac COVID vaccine let-down spotlights mRNA design challenges. Nat. 594:483.
Firdous DL (2020). Benefits of Okra And Its Side Effects. Lybrate, Inc. 2020.
Gemede HF, Ratta N, Haki GD, Woldegiorgis AZ, Beyene F (2015). Nutritional Quality and Health Benefits of Okra (*Abelmoschus esculentus*): A Rev. J. Food Pro. Technol. 6:458.
Hammond-Kosack KE, Atkinson HJ, Bowles, DJ (1989). Systemic accumulation of novel proteins in the apoplast of the leaves of potato plants following root invasion by the cyst-nematode *Globodera rostochiensis.* Physiol. Mol. Pl. Pathol. 35:495-506.
Iqbal S, Fosu-Nyarko J, Jones MGK (2020). Attempt to Silence Genes of the RNAi Pathways of the Root-Knot Nematode, *Meloidogyne incognita* Results in Diverse Responses Including Increase and No Change in Expression of Some Genes. Front. Pl. Sci. 11(328):1-13.
Jixing X., et al. (2021). Whitefly hijacks a plant detoxification gene that neutralizes plant toxins. Cel. 184(7):1693-1705.e17.
Josephson A, Kilic T, Michler JD (2021). Socioeconomic impacts of COVID-19 in low-income countries. Nat. Hum. Behav. 5:557-565.
Kiessig DF, Malamy J (1994). The salicylic acid signal in plants. Pl. Mol. Biol. 26:1439-1458.
Kiessig DF., Durner J, Noad R, Navarre DA, Wendehenne D, Kumar D, Zhou JM, Shah J, Zhang S, Kachroo P, Trifa Y, Pontier D, Lam E, Silva H (2000). Nitric oxide and salicylic acid signaling in plant defense. Proc. Nat. Aca. Sci. USA. 97:8849-8855.
Kochlar SI (1986). Okra (lady finger) in tropical crops, a text book of economic botany. 1:263-264.
Krause PR, Fleming TR, Longini IM, Peto R, Briand S, Heymann DL et al. (2021). SARS-CoV-2 Variants and Vaccines. New Eng. J.Med. 1-8.
Kuc' J, Strobel NE (1992). Induced resistance using pathogens and nonpathogens. In: Biological Control of plant Diseases. Bio. Con. Plant. Dis. 295-300.
Kupferschmidt K, Wadman M (2021). Delta variant triggers new phase in the pandemic. Sci. 372(6549):1375-1376.
Lowry OH, Rosebrough NJ, Farr AL, Randall RJ (1951). Protein measurement with Folin-phenol reagent. J. Biol. Chem. 193:265-275.
Laemmli UK (1970). Cleavage of structural protein during the assembly of the head of bacteriophage T4. Nat. 227:680-685.
Ledford H (2021). First known gene transfer from plant to insect identified. Nat.
Martin YH (2021). COVID-19: Which vaccines are effective against the delta variant?
Mauch-Mani B, Metraux JP (1998). Salicylic acid and systemic acquired resistance to

pathogen attack. Ann. Bot. 82:535-540.
McClure, Michael A, Misaghi I, Night EJ (1973). Shared antigens of parasitic nematodes and host plant. Nat. 244:306.
Merra MS, Shivanna MB, Kageyma K, Hyakumachi M (1994). Plant growth promoting fungi from Zoysia grass rhizosphere as potential inducers of systemic resistance in cucumbers. Phytopathol. 84:1399-1406.
Mukherjee A, Mondal P, Sinhababu SP (2020). Nematode extract-induced resistance in tomato against *Meloidogyne incognita*. Indian Journal of Science and Technology 13(14): 1476-1479.
Nandi B, Sukul NC, Banerjee N, Sengupta S, Das P, Sinhababu SP (2002). Salicylic acid enhances resistance in cowpea against *Meloidogyne incognita.* Phytopathol. Med. 41:39-44.
Nandi B, Kundu K, Banerjee N, Sinhababu SP (2003). Salicylic acid-induced suppression of *Meloidogyne incognita* infestation of okra and cowpea. Nematol. 5(5):747-752.
Rabaan AA, Al-Ahmed SH, Garout MA, Al-Qaaneh AM, Sule AA, Tirupathi R, Mutair AA, Alhumaid S, Hasan A, Dhawan M, Tiwari R (2021). Diverse Immunological Factors Influencing Pathogenesis in Patients with COVID-19: A Review on Viral Dissemination, Immunotherapeutic Options to Counter Cytokine Storm and Inflammatory Responses. Pathogen. 10(5):565.
Rahimi S, Perry RN, Wright DJ (1993) Induction and detection of pathogenesis-related proteins in leaves and roots of potato plants infected with pathotypes of *Globodera pallida.* Fund. Appl. Nematol. 16:549-556.
Rahimi S, Perry RN, Wright DJ (1996). Identification of pathogenesis-related proteins induced in leaves of potato plants infected with potato cyst nematodes, *Globodera species.* Physiol. Mol. Pl. Pathol. 49:49-59.
Ross AF (1961). Systemic acquired resistance induced by localized virus infection in plants. Virol. 14:340-358.
Sandefur J (2021) World Bank grants for global vaccination-why so slow? Nat. 594:475.
Savello PA, Martin FW, Hill JM (1980). Nutritional composition of okra seed meal. J. Agric. Food Chem. 28(6):1163-1166.
Schneider M, Schweizer P, Meuwly P, Metraux JP (1996). Systemic acquired resistance in plants. Int. J. Cytol. 168:303-340.
Sindhu RK, Puri V (2016) Phytochemical, Nutritional and Pharmacological evidences for *Abelmoschus esculentus* (L.). J. Phytopharmacol. 5(6):238-241.
Stephens EC, Martin G, Wijk MV, Timsina J, Snow V (2020). Elsevier Editorial: Impacts of COVID-19 on agricultural and food systems worldwide and on progress to the sustainable development goals. Agric. Syst. 183:102873.
Sukul NC, Sinhababu SP, Datta SC, Nandi B, Sukul A (2001) Nematotoxic effect of *Acacia auriculiformis* and *Artemisia nilagirica* against root-knot nematodes. Allelopathol. J. 8(1):65-72
Wadman M (2021). Scientists tracking coronavirus variants struggle with global blind spots. Science.
Workie E, Mackolil J, Nyika J, Ramadas S (2020). Deciphering the impact of COVID-19 pandemic on food security, agriculture, and livelihoods: A review of the evidence from developing countries. Cu. Res. Environ. Sustain. 2:100014.
World Bank (2021). Food Security and COVID-19. Last Updated: May 07, 2021.
Yousaf A, Hameed Y (2021). COVID-19 and Human Immune Response: A Literature Based Review: COVID-19 and Human Immune Response. Open J. Med. Sci. 1(1):10-14.