Int.J.Curr.Microbiol.App.Sci (2020) *9*(5): 3624-3633

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 5 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.905.430

Effect of N, P, K and Bio-Inoculants on Yield and Yield Attributing Characters of Coriander (*Coriandrum sativum* L.)

A. K. Mishra*, C. S. Choudhary, R. S. Singh and S. P. Singh

Tirhut College of Agriculture, Dholi, Muzaffarpur (RPCAU, Pusa, Samastipur, Bihar), India

**Corresponding author*

Keywords

Inorganic fertilizer, Bio-inoculant, Bacillus, Pseudomonas, PSB, Coriander

Article Info

Accepted:
05 April 2020
Available Online:
10 May 2020

A B S T R A C T

An experiment was conducted to access the effect of varying level ofN, P, K (50, 75 and 100%of recommended dose of N:P:K :: 50:40:40) and three different bio-inoculants(*Bacillus, Pseudomonas* and PSB) on vegetative growth and yield of coriander at Tirhut College of Agriculture, Dholi (Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar) during *Rabi* season 2016-17 to 2018-19. The application of RDF (100% N,P & K) + *Bacillus* (10kgha^{-1}) influenced most of the yield attributing characters consequently resulting in highest yield and realization of highest cost benefit ratio. Maximum number of primary and secondary branches per plant (7.48 & 27.50), number of grains per umbel (49.15),grains per umbellet (7.84), yield per hectare (23.07 q)and highest return of Rs. 2.19 per unit cost with highest net profit of Rs. 99,165.00 per hectare was found in treatment, T_3- 100% N,P & K + *Bacillus*. The next effective treatment in terms of yield and economics was T_6: 100% N, P & K + *Pseudomonas*, which resulted in grain yield of 22.76 qha^{-1}and cost benefit ratio of 1:2.04 with net profit of Rs. 91,680.00 per hectare.

Introduction

Coriander is one of the most important spices crop considered under seed spices. India is the largest producer of coriander in the world and the major portion is consumed within the country itself. In India, coriander is grown in an area of 5.53 lakh hectare with an annual production of 4.62 lakh tonnes with an average yield of 835kg ha^{-1} (Annon., 2016). Coriander is used in two forms *i.e.*, as fresh green herb and seeds which are used for flavouring the food. The colour and flavour of these two products are markedly different. The green herb is mostly preferred for culinary flavouring purpose. One the other hand, the whole seed or powdered form is considered as an important spice commodity of international trade and used widely as flavouring substance. The dried ripe fruit of coriander contains volatile oil, tannins, cellulose, proteins, pigments, calcium oxalate, minerals and sugar. The major constituents of coriander seed are fibber about (23-36%),

carbohydrate (20%), fixed oil (16-28%) and proteins (11-17%). Coriander seed contains two types of oil *i.e.,* the essential oil and the fatty oil (Ramachandraiah *et al.,* 1989). It is used for various purposes such as flavoring sweets, beverages, tobacco products, baked goods, and as a basic ingredient for curry powder (Mahendra *et al.,* 2011). Also includes borneol, p-cymene, alphapinene, camphor, geraniol, and limonene. Fatty oil (13%–20%): acid, oleic, and linoleic (Mandal *et al.,* 2015).

Indiscriminate use of inorganic fertilizers and pesticides has caused health hazards to human, besides deteriorating the soil, ground water and environmental ecology. Bio-fertilizer holds a vast potential for supply of major plant nutrients like nitrogen and phosphorus more economically. However, bio-fertilizers if supplemented with the chemical fertilizer they can reduce the need of chemical fertilizer by 25-30 per cent. Thus, there is need to integrate and balance the supply of chemical fertilizers, organic manures and bio-fertilizers for sustaining productivity, soil health with a view to supplement a part of chemical fertilizers requirement through these resources. It is imperative to explore the possibility of supplementing chemical fertilizer with eco-friendly low cost input of bio-fertilizer *viz;*Azospirillum, Azotobactor and Phosphorus Solubilizing Bacteria (PSB), These microbial inoculants improves nutrient availability resulting in enhancing growth, yield and quality of spices crops, besides reducing the quality of inorganic nitrogen, phosphatic and potassic fertilizer (Bahadur and Manohar, 2001; Bahadur and Singh, 2004; Singh *et al.,* 2010 and Chatto *et al.,* 2007). Keeping in view their significance present investigation was under taken to assess the effect of combined application of chemical fertilizers and bio-fertilizers to increase yield of coriander.

Materials and Methods

The experiment was conducted for three years during Rabi season of 2016-17, 2017-18& 2018-19 at the experimental fields of Tirhut College of Agriculture, Dholi of Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar. Results were presented based on pooled data of all the three years of experimentation. The soil of experimental plots was sandy loam with pH-7.6, EC-0.39 dsm^{-1}, organic carbon 0.38% and available N,P & K was 114.0, 16.0, 100.00kg ha^{-1}, respectively. The experiment was laid out in RBD design with three replication using coriander variety, Pant Haritima. The plot size of experiments was 3.0 x 2.0m and sowing of crop was done in experimental year during first week of November at spacing of 30 x 25cm.

The treatments comprised of ten combination of bio-inoculants and major inorganic fertilizer (N, P & K) as follows:

T_1: 50% N (100% P & K) + *Bacillus*
T_2: 75% N (100% P & K) + *Bacillus*
T_3: 100% N, P & K + *Bacillus*
T_4: 50% P (100% N & K) + *Pseudomonas*
T_5: 75% P (100% N & K) + *Pseudomonas*
T_6: 100% N, P & K + *Pseudomonas*
T_7: 50% K (100% N & P) + PSB
T_8: 75% K (100% N & P) + PSB
T_9: 100% N, P & K + PSB
T_{10}: Control (100% N, P & K)*i.e*., RDF: NPK::50:40:40kg/ha.

Inorganic fertilize, phosphorus and potash were applied at the time of field preparation while nitrogenous fertilizer was applied at 40-50 days after sowing. Bio-inoculants *i.e., Bacillus*, *Pseudomonas* and PSB were applied @10kg ha^{-1} and each bio-inoculants were mixed with 10 quintal well rotten FYM prior to field application. Each bio-inoculants was applied separately at 45 days after sowing at

adequate moisture level condition in the soil. Observation on growth and yield parameters were recorded from ten random selected plants from each replication using standard procedure. The characters *viz.,* height of the plant, number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of umbels plant^{-1}, number of umbellets per umbel number of grains umbel^{-1}, number of grains umbellets^{-1} and yield per plot and yield per hectare were recorded.

Results and Discussion

Effect of different treatments on yield and different yield attributing characters has been described in this section. Yield and all the yield attributing characters showed significant increase in all the treatments over application of recommended dose of fertilizer (100% N, P & K). Highest significant plant height (143.89cm) was recorded with treatment, T_6: 100% N,P & K + *Pseudomonas* followed by T_9: 100% N, P & K + PSB *i.e.,* 142.77cm. Maximum number of primary branches plant^{-1} (7.48) was observed with treatment, T_3: 100% N, P & K + *Bacillus* followed by T_8: 75% K (100% N & P) + PSB *i.e.,* 7.22 (Table 1). However, the highest number of secondary branches plant^{-1} (27.50) was observed with treatment, T_3: 100% N,P & K + *Bacillus* followed by T_6: 100% N, P & K + *Pseudomonasi.e.,*26.87 (Table 2). The above findings are in agreement of findings of Mohammed Abdalkadar *et al.,* (2018); Kamrozzaman *et al.,* (2016) and Yousufl *et al.,* (2014).

The improvement in plant height, number of primary branches plant^{-1} and number of secondary branches plant^{-1} was due to proper development of the root system and increase in root branches, which lead increased uptake of nutrients as well as growth promoting hormones like- IAA, GA, Cytokinin produced by microbes near root zone (Anuburani and Mani Vannan, 2002: Choudhary and Vihol, 2011). Thus, Phoshporous solubilizing bacteria might help in conversion of unavailable phosphorus to the available from especially in yearly crop growth phase. Another mechanism by which Phoshporous solubilizing bacteria augment the plant growth is by the biosynthesis of growth promising substance like- Vitamin B.

Yield and yield related attributes of coriander *viz;* number of umbels plant^{-1}, number of umbellets umbel^{-1}, number of grain umbel^{-1}, number of grains umbellets^{-1} and yield quintal per hectare was significantly increased by application of 100 per cent recommended dose of chemical fertilizer along with bio-inoculants *viz;* Bacillus, Pseudomonas or Phoshporous solubilizing bacterial. Yield and all yield attributing characters were found significant as compared to control. Table 2 also indicates highest number of umbel plant^{-1} (53.87) followed by 52.92 in treatmentT_6: 100% N, P & K + *Pseudomonas* andT_3: 100% N, P & K + *Bacillus* respectively. Highest number of umbellets umbel^{-1} (7.32) was found in treatment T_6: 100% N,P& K + *Pseudomonas* followed by T_3: 100% N, P & K + *Bacillus*(7.11). Highest number of grain per umbel as well as number of grain per umbellet, 49.15 and 7.84 followed by 49.00 and 6.93 were recorded in treatment T_3: 100% N, P & K + *Bacillus* and T_6: 100% N, P & K + *Pseudomonas* respectively(Table 3 & 4). Similar trends in findings were found in the studies carried by Chitra and Shoba (2019); Kutlu *et al.,* (2019) and Lathal *et al.,* (2018).

Table 4 projects highest significant yield of 23.07 qha^{-1} (42.23% increase over control) followed by 22.76 qha^{-1}in treatment, T_3: 100% N, P & K + *Bacillus* and T_6: 100% N, P & K + *Pseudomonas* respectively. Similar observations were also made by Chatto *et al.,* (2007); Singh *et al.,* (2010); Choudhary and Vihol (2011) and Dixit *et al.,* (2007).

Table.1 Response of different level of N, P & K application with bio-inoculants on plant height and number of primary branches of coriander.

Treatment	Height of the plant			Mean	No. of primary branches per plant			Mean
	2016-17	2017-18	2018-19		2016-17	2017-18	2018-19	
T_1: 50% N (100% P & K) + *Bacillus*	126.27	133.11	136.55	131.98	5.67	5.33	6.56	6.19
T_2: 75% N (100% P & K) + *Bacillus*	137.93	133.77	136.44	136.05	7.33	6.78	6.78	6.96
T_3: 100% N, P & K + *Bacillus*	147.73	135.67	138.67	140.69	8.10	6.89	7.44	7.48
T_4: 50% P (100% N & K) + *Pseudomonas*	127.00	133.89	137.22	132.70	5.73	6.44	6.33	7.17
T_5: 75% P (100% N & K) + *Pseudomonas*	129.13	141.78	134.56	135.16	6.27	6.78	6.89	6.45
T_6: 100% N, P & K + *Pseudomonas*	142.67	143.11	145.89	143.89	6.33	6.89	6.58	6.60
T_7: 50% K (100% N & P) + PSB	128.47	132.78	135.44	132.23	6.60	6.78	7.22	6.87
T_8: 75% K (100% N & P) + PSB	131.33	137.00	139.56	135.96	7.33	7.11	7.22	7.22
T_9: 100% N, P & K) + PSB	139.20	142.00	147.11	142.77	7.73	8.33	8.67	6.30
T_{10}: Control (100% N, P & K)	113.20	114.99	117.56	115.23	7.13	5.11	5.22	5.82
CD (*p*=0.05)	NS	5.09	4.16	6.75	1.42	1.11	0.95	1.02
CV(%)	11.22	5.23	6.92	3.95	11.86	9.38	7.77	8.52

Table.2 Response of different level of N, P & K application with bio-inoculants on number of primary branches and umbels of coriander.

Treatment	No. of secondary branches per plant			Mean	No. of umbels per plant			Mean
	2016-17	2017-18	2018-19		2016-17	2017-18	2018-19	
T_1: 50% N (100% P & K) + *Bacillus*	20.60	16.11	19.67	18.79	35.80	35.32	39.67	36.93
T_2: 75% N (100% P & K) + *Bacillus*	27.87	18.67	21.11	22.55	51.60	40.67	45.00	45.72
T_3: 100% N, P & K + *Bacillus*	30.80	23.92	27.78	27.50	71.33	41.89	50.00	52.92
T_4: 50% P (100% N & K) + *Pseudomonas*	20.27	18.44	21.33	19.35	46.73	35.33	39.89	40.65
T_5: 75% P (100% N & K) + *Pseudomonas*	22.80	19.22	22.56	21.53	41.07	42.67	47.00	43.58
T_6: 100% N, P & K + *Pseudomonas*	33.40	22.22	25.00	26.87	50.27	53.67	56.67	53.87
T_7: 50% K (100%N & P) + PSB	20.60	19.67	22.89	21.05	44.20	42.56	47.45	44.74
T_8: 75% K (100%N & P) + PSB	27.33	20.44	27.22	25.00	53.87	40.11	48.78	47.59
T_9: 100% N, P & K + PSB	33.42	21.77	28.55	18.91	57.87	47.78	46.24	50.63
T_{10}: Control (100% N, P & K)	20.60	13.22	16.67	16.80	34.93	32.56	37.22	34.90
CD (*p*=0.05)	7.87	2.25	3.79	5.56	15.00	10.20	9.13	9.21
CV(%)	17.14	6.96	9.43	14.15	17.93	14.42	10.17	11.80

Table.3 Response of different level of N, P & K application with bio-inoculants on number of umbellets and gains per umbel of coriander.

Treatment	No. of umbellets per umbel			Mean	No. of grains per umbel			Mean
	2016-17	2017-18	2018-19		2016-17	2017-18	2018-19	
T_1: 50% N (100% P & K) + *Bacillus*	5.47	5.56	5.78	5.60	33.67	31.11	40.11	34.96
T_2: 75% N (100% P & K) + *Bacillus*	6.13	6.00	6.11	6.08	42.27	35.89	45.44	41.20
T_3: 100% N, P & K + *Bacillus*	6.42	7.34	7.56	7.11	52.80	42.44	52.22	49.15
T_4: 50% P (100% N & K) + *Pseudomonas*	6.07	5.56	6.67	6.43	33.40	39.33	48.56	40.43
T_5: 75% P (100% N & K) + *Pseudomonas*	5.73	7.11	7.11	6.65	31.93	37.78	46.56	38.76
T_6: 100% N, P & K + *Pseudomonas*	5.72	7.85	8.40	7.32	46.41	55.22	44.86	48.83
T_7: 50% K (100%N & P) + PSB	6.23	6.33	6.67	6.41	31.63	41.33	50.67	41.21
T_8: 75% K (100%N & P) + PSB	5.33	7.22	7.44	6.66	33.27	44.67	53.89	43.94
T_9: 100% N, P & K + PSB	6.23	7.13	7.64	7.00	56.39	49.67	40.94	49.00
T_{10}: Control (100% N, P & K)	5.73	4.78	5.11	5.21	32.33	26.00	35.33	31.22
CD (*p*=0.05)	NS	0.77	0.95	1.09	9.31	4.71	9.33	9.19
CV(%)	7.87	6.94	7.99	9.81	14.75	6.82	10.96	12.68

Table.4 Response of different level of N, P & K application with bio-inoculants on number of gains per umbellets and yield of coriander.

Treatment	No. of grains per umbellet			Mean	Yield q ha^{-1}			Mean
	2016-17	2017-18	2018-19		2016-17	2017-18	2018-19	
T_1: 50% N (100% P & K) + *Bacillus*	7.00	5.78	6.56	6.45	16.45	19.94	17.72	18.04
T_2: 75% N (100% P & K) + *Bacillus*	7.13	6.33	6.45	6.64	17.78	20.67	20.22	19.56
T_3: 100% N, P & K + *Bacillus*	7.53	8.00	8.00	7.84	21.83	23.94	23.44	23.07
T_4: 50% P (100% N & K) + *Pseudomonas*	6.33	5.89	6.00	6.07	16.33	21.61	21.00	19.65
T_5: 75% P (100% N & K) + *Pseudomonas*	6.67	6.89	7.11	6.89	16.89	23.44	18.89	19.74
T_6: 100% N, P & K + *Pseudomonas*	7.13	6.11	7.55	6.93	18.95	27.86	21.50	22.76
T_7: 50% K (100%N & P) + PSB	6.95	6.45	6.56	6.65	15.67	22.34	17.72	18.58
T_8: 75% K (100%N & P) + PSB	6.67	7.67	7.88	7.41	17.17	24.00	22.44	21.20
T_9: 100% N, P & K + PSB	7.40	6.67	8.49	7.52	20.61	21.72	23.22	21.85
T_{10}: Control (100% N, P & K)	6.20	4.66	5.33	5.56	15.56	17.00	16.11	16.22
CD (p=0.05)	NS	0.82	1.07	1.09	1.62	2.03	2.47	2.51
CV(%)	7.82	6.89	8.66	9.04	5.33	5.19	7.13	7.24

Table.5 Effect of different level of N, P & K application and bio-inoculants on economics of coriander.

Character Treatment	Mean yield (q ha^{-1})	Gross income (Rs. ha^{-1})	Cost of cultivation (Rs.ha^{-1})	Net profit (Rs.ha^{-1})	C: B ratio
T_1: 50% N (100% P & K) + *Bacillus*	18.04	1,08,240	44,865	63,375	1:1.41
T_2: 75% N (100% P & K) + *Bacillus*	19.56	1,14,060	45,063	72,297	1:1.60
T_3: 100% N (100% P & K) + *Bacillus*	23.07	1,38,420	45,255	99,165	1:2.19
T_4: 50% N (100% P & K) + *Pseudomonas*	19.65	1,17,840	43,880	73,960	1:1.69
T_5: 75% N (100% P & K) + *Pseudomonas*	19.74	1,18,440	44,384	74,056	1:1.67
T_6: 100% N (100% P & K) + *Pseudomonas*	22.76	1,36,560	44,880	91,680	1:2.04
T_7: 50% N (100% P & K) + PSB	18.58	1,11,480	44,580	66,900	1:1.50
T_8: 75% N (100% P & K) + PSB	21.20	1,27,200	44,736	82,464	1:1.84
T_9: 100% N (100% P & K) + PSB	21.85	1,31,100	44,880	86,220	1:1.92
T_{10}: Control (100% N, P & K)	16.22	97,320	43,380	53,940	1:1.24

Inorganic fertilizer	Bio-fertilizer
Urea: Rs. 296/- per 50kg bag	*Bacillus*: Rs. 125/- per kg
SSP: Rs. 400/- per 50 kg bag	*Pseudomonas*: Rs. 100/- per kg
MOP: Rs. 600/- per 50kg bag	PSB: Rs. 100/- per kg

The increase in yield attributes may be due to better root proliferation, uptake of nutrients and water, enhanced photosynthesis, production of more foliage leading to food accumulation.

Also, the increased availability of atmospheric nitrogen and soil phosphorus by microbial inoculants might have played a vital role in increasing the yield and yield attributes in coriander.

Effect of different treatments on economics of crop is presented in Table 5. The cost of cultivation was recorded highest (Rs. 45,255.00) in treatment T_3: 100% N, P & K + *Bacillus* followed by Rs. 45,063.00 in treatment T_2: 75% N (100% P & K) + *Bacillus*.

However, the highest gross income and return of Rs.1,38,420.00 and Rs.99,165.00 was recorded in treatment T_3: 100% N, P & K + *Bacillus*. The second highest gross income of Rs. 1,36,000.00 and consequently next best return of Rs.91,680.00 was realized in treatment T_6: 100% N, P & K + *Pseudomonas*. The benefit cost ratio was markedly influenced by different treatment which was highest (1:2.19) in treatment T_3: 100% N, P & K + *Bacillus* followed by T_6: 100% N, P & K + PSB (1:2.04).

Cost of cultivation (Field preparation, sowing, weeding, irrigation, spraying of plant protection chemicals, harvesting, threshing & cleaning) = Rs. 40,000.00/ha.

Cost of bio-fertilizer (per hectare)

Bacillus @ 10kg ha^{-1} x Rs. 125/kg = Rs. 1875.00, *Pseudomonas* @ 10kg ha^{-1} x Rs. 100/kg= Rs. 1500.00 and PSB @ 15kg ha^{-1} x Rs. 100/kg = 1500.00

Selling rate of coriander = Rs. 6000.00qt.

References

Annonymous, 2016. *Spices statics at a glance 2016* published by The Director, Directorate of Arecanut and Spices Development, Kozhikode, Kerala. 156p.

Anuburani, A. and K. Manivannan, 2002. Effect if of integrated nutrients management on growth in brinjal cv. Anna Malai. *South Indian J. Hort*. 50 (4-6): 377-86.

Bahadur, A. and P. K. Manohar, 2001. Response of Okra to bio-fertilizer. *Veg. Sci.* 28 (2): 197-198.

Bahadur, A. and K. P. Singh, 2004. Response of cabbage to organic manures and bio-fertilizer. *Indian J. Hort.* 61 (2): 175-179.

Chato, M. A., N. Hamed, S. Fahemma, S. Narayan, S. H. Khan and K. Hussain, 2007. Response of garlic (*Allium sativum* L.) to bio-fertilizer application. *The Assian J. Hort.* 2 (2): 249-252.

Chitra, L. R. and N.Shoba, 2019. Effect of nutrients and growth regulator on growth and leaf yield of offseason coriander, *Coriandrum sativum*.Journal of Crop and Weed. 15(2): 90-93.

Choudhary, B. K.and J. J. Vihol, 2011. Efficacy of bio-fertilizer and fertilizers on growth and yield of brinjal cv. GOB-1. *The Asian J. Hort.* 6 (1): 41-42.

Dixit, S.K, S. Kumar, M. L. Meena and R. B. Ram. 2007. Bio-fertilizer may be substitute of chemical fertilizer. *The Asian J. Hort.* 2 (2): 298-300.

Kamrozzaman, S., S. Ahmed and A. F. M. R., Quddus, 2016. Effect of fertilizer on coriander seed production. *Bangladesh J. Agril. Res*. 41(2): 345-352.

Kutlu, M., R. Cakmakci, A. Hosseinpour and

H. Karagöz, 2019. The use of plant growth promoting rhizobacteria (pgpr)'s effect on essential oil rate, essential oil content, some morphological parameters and nutrient uptake of turkish oregano. *Applied Ecology and Environmental Research.*17(2):1641-1653.

Lathal, B., M. K. Shivaprakash, N. Devakumar and N. Mallikarjuna, 2018. Evaluation and Effect of Microbial Inoculants for Production of Growth Hormones and Organic Formulations on Growth of Baby Corn (*Zea mays* L.) under Green House Condition. *Int. J. Curr.Microbiol. App. Sci*.: 7(10): 2167-2179.

Mahendra, P. and S. Bisht, 2011. *Coriandrum sativum*: A daily use spice with great medicinal effect. *Pharmacognosy Journal*, 3(21), 84-88. 11.

Mandal, S.andM. Mandal, 2015. Coriander (*Coriandrum sativum* L.) essential oil: Chemistry and biological activity. *Asian Pacific Journal of Tropical Biomedicine*, 5(6), 421-428.

Mohammed Abdelkader, A.I., S.H, Ahmed Gendy, A. Inas Bardisiand A. Hend Elakkad, 2018. The impact of NPK fertilization level and Lithovit concentration on productivity and active ingredients of *Coriandrum sativum* plants. *Middle East Journal of Applied Sciences.* 08 (03): 827-836.

Ramachandraiah, Q.S, G. Azeemoddin and S. D. T. Rao, 1989. Integrated method of obtaining essential and fatty acids from umbelleferrous seeds. *Indian perfumer*. 32 (1): 50-60.

Singh, J.K,, A. Bahadur, N. K. Singh and T. B. Singh, 2010. Effect of using varying level of NPK and bio-fertilizer on vegetative growth and yield of okra (*Abelmoschus esculentus* (K) Moe) *Veg. Sci*. 37(1):100-101.

Yousuf1, M. N., S. Brahma, M. M. Kamal, S. Akter and M. E. K., Chowdhury, 2014. Effect of nitrogen, phosphorus, potassium, and sulphur on the growth and seed yield of coriander (*Coriandrum sativum* L.). Bangladesh J. Agril. Res. 39(2): 303-309.

How to cite this article:

Mishra, A. K., C. S. Choudhary, R. S. Singh and Singh, S. P. 2020. Effect of N, P, K and Bio-Inoculants on Yield and Yield Attributing Characters of Coriander (*Coriandrum sativum* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(05): 3624-3633. doi: https://doi.org/10.20546/ijcmas.2020.905.430