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RESEARCH ARTICLE

VERIFYING POTENTIAL OF *MORINGAOLEIFERA* EXTRACT APPLICATION AS BIO- FERTILIZER FOR BASIL PLANTS ELICITED WITH GAMMA IRRADIATION AND / OR NANO- ZINC OXIDE TO AMELIORATE BIOMASS QUANTITY AND QUALITY

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ABSTRACT

Medicinal plants are in exhaust table source of bioactive secondary metabolites since, the side effects of chemical drugs and the human tendency to make greater use of natural products in order to keep their health as well as problems of modern medicinal system caused more attention of human to medicinal plant. Thefore the present investigation offers an efficient Co- friendly approach to enhance biomass and bioactive secondary metabolites production and quality for sweet Basel, medicinal and aromatic plant. Basel seeds were elicited with exposure to gamma ray doses 0,25,50,150 Gy (G1-4) as physical elicitor, then were planted in field experiment at complete randomized block design for three replicates. plants were ,sprayed solitary fertilized by Moringa leaves aqueous extract (MLE) 0.5%, and NPK 0.5% as. Plants at 5,8,10 month aiged were elucidated, foliarly sprayed, with nano – zinc oxide concentration 0,30,50, 80ppb (Z_{1-4}) .statistical analysis of variance for recording data on growth, biomass and bioactive secondary metabolites production revealed that, G2,3,4 and Z2,3,4 performed positive significant impact on recorded data under MLE that exceeded significantly under NPK, aside Z_{2-4} excel G_{2-4}. Whereas G integrated with Z achieved synergistic significant positive impact at which GZ integration under MLE excel significantly under NPK application. therefore, the overall results manifest strong field evidence that G,Z, GZ under investigation, could be considered as oriental technological tool reliant at field application ameliorate biomass and bioactive secondary metabolites production and of quality under MLE biofertilize which exceeded NPK application.

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INTRODUCTION

Sweet Basil (*Ocimumbasilicum* L) widely distributed through the worm regions of the world as herbaceous plant with extraordinary medicinal, aromatic and culinary properties (1-4). Basil has a high market demand and commercially important use in culinary application, food flavorings, preservatives, and cosmetics, pharmaceutical and industries (5). The medicinal, culinary and aromatic value depending on its bioactive phytochemical constituents included; alkaloids, flavonoids, phenolics, terpenoids, and essential oil (6-10). Leaves, stems, roots, flowers and seeds have a plethora of biological and pharmacological activities including; antioxidant, anti- inflammatory anti- allergic, immunomodulatory, anti- coagulant, anti- microbial, anti-stress, anti- ulcer, wound healing, anti- cataract, analgesic, antipyretic, anti- hypertensive, anti- diabetic, anti- fertility, central nervous system depressant, cardio protective, gastro protective, hepatoprotective, Reno protective, radio protective, chemo preventive and anti- cancer properties (11-23).

Basil essential oil responsible for characteristic aroma and biological activities, can be used in diverse applications in pharmacological, food, perfume and cosmetic industries. Also, it have the potential to be used as food preservative for cereals, grains, pulses, fruits and vegetables. Further, the use of essential oil with special emphasis on its antibacterial, bactericidal, antifungal and food preservative properties because its consist of a variety of active constituents. These various properties of Basil offer the possibility of using natural, ecofriendly, cost effective, renewable and easily biodegradable antimicrobials for food commodity preservation in the near future (23-28). The dependency on the use of inorganic fertilizer as source of plant nutrients by farmers and their cost is farther associated with land and soil degradation and environmental pollution (29). Thus there is continuous need to search for alternative safe natural sources of plant nutrients. FAO considered that organic agriculture is an effective mitigation strategy to climate change and can build robust soils that adopt better to weather extremes associated with climate changes. It is observed that innovative crops

cultivated under organic system present better quality and similar yields as with those cultivated under conventional system, and in some cases, even higher. Talking all these into account, organic agriculture could also be characterized as innovative and not only as traditional (30). Today, using symbiotic microorganisms with plants as the biofertilizers for providing nutrients is considers (31-34). *Moringaoleifera* L(MO) is cultivated all over the world as it is commonly used as nutritional and medicinal plant (35-36). It is called "Miracle vegetable" because it is both a medicinal and functional food has been use in human and animal nutrition. The young leaves lowers and green pods are common vegetables in various parts of the world (37).Every part of this highly esteemed tree have long been consumed by human and used for various animal forage, fertilizer, foliar nutrient, green manure, biopesticid, water purification, lubrication oil) manufacture of perfume and hair car products (38). Different parts of this plant contain or profile of important minerals, proteins, vitamins, B. carotene, amino acids and various phenolics and provide a rich and rare combination of zeatin with several flavonoids pigments (39-41). So it is a goodsource of natural anti- oxidants (42). MOtree ranged height from 5 to 10m., it is found wild and cultivated in many countries of the tropics and subtropics (35). It is considered as one of the world is most useful trees, as almost every part of the tree has an impressive effect of food medication and industrial purposes (43-44). Moringais one of such alternative being investigated to ascertain its effect on growth and yield of crops and thus can be promoted among farmers as a possible supplement or substitute to inorganic fertilizers (29). Further, several researches have indicated that MO (Family Moringaceae) is a highly valued plant with multipurpose effects (44-47، 41).

It has been extensively investigated that pre- sowing seeds subjected to low gamma irradiation doses may be potentialize growth biochemical and dry biomass production as well as prefill of bioactive secondary metabolite (48-50)Also, elicitation with biotic, abiotic, or physical elicitor (51) represented a useful biotechnological tool to improve the production of secondary metabolites (52-54). Exceedingly since, nono- technology can represent solution to increase the value of agriculture products and reducing environmental problems. The effect of nano- particles on plants can be bicaenifl (55-58). Nano- Particle, recently using in plants or plant extracts are very attractive and co- Friendly alternative to chemical and physiological methods (59-64). The production of SMs is very low (less than 1% dry weight) and mainly depends of the physiological and developmental stage of plant (65-66). Several biotechnological strategies have been applied to enhance the productivity of desirable SMs from cell, organ and plant (67-68). Elicitation with abiotic and biotic elicitor is one of few strategies that commercial applicationin the improvement of bioactive secondary metabolites production from plants as well as celland organ cultures (69-74). Nowadays agricultive needs crop sustainability and the organic cropping system has emerged as an interesting alternative approach with respect to conventional one. On the other hand, the current unfavorable yield gap between organic cropping system has emerged as an interesting alternative approach with respect to conditional one. On the other hand, the current unfavorable yield gap between organic and conventional systems reduces the organic and conventional systems reduces the organic system's value. Considering the above side according to recent trend and future prospects of various strategies to direct higher than the average biomass and bioactive secondary metabolites productivity in medicinal and aromatic plants are highlighted. Therefore, field experiment was conducted to evaluate MLE as biofertilizer compared with chemical NPK fertilizer for Basel plants elicited with gamma irradiation and nano- Zinc oxide as elicitors.

MATERIALS AND METHODS

Gamma irradiation: Pre-Sowing sweetBasel, *ocimumbasilicm* L., (SB) seeds (8% moisture) were subjected to gamma irradiation doses 0,25,50,75Gy (G_{1-4}) emitted from Co-60 gamma ray source at 1.5KGy/h dose rate.

Execute field experiment: At 20 March, 2017, gamma irradiated SB seeds were sown in trays contained soil sand, beat mixed (1:1:1 ratio V/V) subsequently established in greenhouse. Seedlings 4 weeks old were transplanted to field experiment in complete randomized block design for 3 replicates in plots 3x7m, consist 6 rows 60cm apart and 25 cm interspacing, i.e 140 plant plot (6.7 plant /m^2) and to give target plant population 28140plant per feedan or 67000 plant / ha. Brackish shallow well water 900ppm were used for irrigation though surface drip irrigation system.

Fertilization: Nano- zenc oxide application: Plants 2 month old were multi- repeating elucidated by foliar spraywith nano-zenc- Oxide (20nm) at 0, 30, 50, 80 ppb. concentration, every month i.e. 2 time/ each cut.

Biometric field quantitative traits: The field experiment was harvested for 3 harvests (every 3 months from transplanting), 5 representive plants / cut for Growth traits, plant height, cm (PH) and fresh herbage weight / plant, g(FHY/P). the means for these 5 plant that were subjected for statistical analysis. Whereas, biomass as fresh herb yield / plot weredried up tell 8% humndity the weighted as dry herb yield / plant that converted to dry herb yield /m^2/ Cut. Total DHY, g/ m^2 for 3 cuts that were subjected to ANOVA statistical analyses as biomass yield production.

Bioactive secondary metabolites (BSMs)

Essential oil % (EO%)

EO%: EO was determined according toMasong**(75).** by continuous extraction (Soxilet) with acetone. The volatile oil solution obtained is evaporated under reduced pressure, in rotatory evaporator. The oil was weighted and stored in amber colored bottles at 20°C till to the farther analysis.

EOY, g/m^2 (Eoy,g/m^2): EOY, g/m^2 were determined by multiplying dry herb yield, g/m^2 with EO%.

EO content: A GC with a FID detector was used to determine essential oil fraction in the dry basil herb samples. Separation was performed using H-P-5 (Cross linked 5% ME siloxane, 15mx0.53mmx1.5µm film) column at helium flow rate 2ml/min, injection temperature program 60°C, 40°C µp to 220°C, 2min at 220°C. Portions of 2µl. of an essential oil solution in hexane were injected onto the analytical column.

Phenolic compounds: Dry herb sample (2g) were extracted with ethanol (20ml) overnight in a shaker at room temperature

followed filtration through watman No. 1 filter paper the residues were re- extracted under the same conditions, the combined filtrates were evaporated in rotatory evaporation below 40°C. the obtained extracts after evaporation were weighted to determine the extract yield and stored until further use.

Total phenolic content (TPC): TPC was analyzed by folin-Ciocalteau colorimetric method **(76).**Methanolic extracts (0.1ml) were mixed with 2.5ml distilled water, follodby the addition of 0.1ml (2N) folin – Ciocalteau reagent. Then, 0.5ml 20% Na_2CO_3 was added after 5min and mixed well. The color was developed after 30min in the dark at 24°C and the absorbance was measured at 760nm by visible spectrophotometer. The absorbance was calibrated using a standard using a standard curve with gallic acid and were expressed as mg of gallic acid equivalent per gram dry weight of leaves.

Total flavonoid content (TFC): TFC was determined calorimetrically using the method described by**(77).** The methanolic herb extract and standard (0.25ml) were mixed with 1.475ml distilled water. Then, 0.075ml. 5% NaNO solution was added. After 5min, the absorbance was measured at 510nm using spectrophotometer. The absorbance were expressed as mg of catechin equivalents per gram dry weight.

Identification of flavonoids : UHPLC, was used to separate and identify the flavonoids. The chromatographic system condition were set as follows; mobile phase, 0.03M orthophosphoric acid (A) and methanol HPLC grade (B); detector, UV280-360nm, C_{18} Column (5.0µm, 4.6mm inner diameter [ID] X250mm); column oven temperature, 35°C; and flow rate, 1.0ml/min, Gradient elution was performed as follows; 0-10m in, 10% B; 10-15m in, 50% B; 15-20min; 100%B; and finaly 5min for washing. Standards of, quercetin, kaempferol, rutin were used.

Statistical Analysis: All data were analyzed as a completely randomized design with three replicates. Means between treatments were separated by analysis of variance (ANOVA) and then statistically significant differences were assessed by calculated least significant difference (LSD) at 1% level. Plants were fertilized by foliar spray with two sole, fertilizers; NPK 15: 15: 15 (200Kg/ ha) and *Moringaoleifera* L aqueous leaves extract (MLE), 0.5%.MOleaves were purchased from herbal market (Cairo, Egypt), were powdered and passed.through sieve No, 20, Aqueous extract 100gm. with 600ml. of water in a soxhlet extractor for18-20h. the extract was concentrated to dryness. Under reduced pressure and controlledtemperature (40-50°C). the extract was dissolved with water to get 0.5% concentration whichhas been used as bio- fertilizer.

RESULTS

Growth parameters

Plant height, Cm (PH): Mean of 5 representative, plantheight, cm (PH) at 1-3 cut as well as its pooled for MLE were significantly increased by 3% over NPK application $G_{2,3,4}$also increase 7,5,3% of control under NPK at that 8, 6, 4% of control under MLE application respectively ($Table_1$).$Z_{2,3,4}$also achieved significantly scale up (PH) to 8,6,4% of control at NPK aside, 9,7,5% over control for MLE, respectively. Concerning, $G_{2\text{-}4}$ integrated with $Z_{2\text{-}4}$actuated synergistic significant increase (PH) ranged up to, 11-18%over control for MLE and 9-16% over controlfor NPK.Exceedingly G_2Z_4 achieved the best highest16, 18% for NPK and MLE respectively ($Table_2Figure_1$).

Fresh herb yield, g/ plant (FHY/P): At such 1-3 cut, the mean (FHY/P) as well as itspooled mean. significantly by 2% for MLE than for NPK application at control level (table 1) $G_{2\text{-}4}$ acted significant increment (FHY/P) 6,3,2% control for NPK and 8, 5, 4% control for MLE. While $Z_{2,3,4}$ actuated 4,5,8% control for NPK and 6,7,10% control for MLE application, respectively. At that, $G_{2\text{-}4}$ integrated with $Z_{2\text{-}4}$.Impacted synergistic increment (FHY/P) ranged 11-21% over controlfor NPK and 15-23% for MLE application. Further G_2Z_4represented the best application21,23% for NPK and MLE, respectively (Table 1).

Biomass production

Dry herb yield / m^2: (DHY, g/m^2): DHY g/ m^2, 456.9 at NPK application (as standard control) whereas MLE application was 470.69. exceeded significantly 3% over NPK application ($Table_2$). $G_{2\text{-}4}$ actuated significant appraise up to 8, 5, 4% over control at MLE aside. 7,4.3% over control at NPK application. $Z_{2\text{-}4}$ achieved significant increase (DHY, g/m2) by 6,7,10 % over control at MLE and 5,6, 9% over control at MLE, respectively ($Table_2$). $G_{2\text{-}4}$ integrated with $Z_{2\text{-}4}$ resulted in significant synergistic positive impactfor (DHY, g/m^2) ranged 14-24% over control at MLE and at 12-22% over control at NPK application. G_2Z_4, Showed the best highsDHY, g/m^2 as 24, 22% of control at MLE and NPKapplication, respectively ($Table_2$,Figure1).

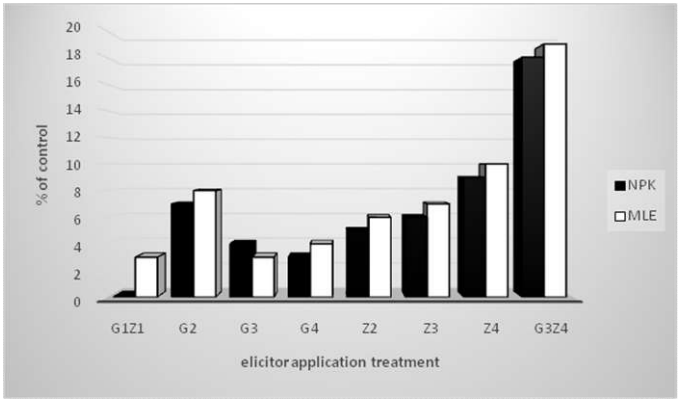

Figure 1. Dry herb yield g/m2

Bioactive secondary metabolite(BSMs):

Essential oil (EO)

Essential oil percent (EO %): EO %, 0.411 for NPK (as standard control) increased significantly for 0.428 as 5% over NPK control ($Table_2$).$G_{2\text{-}4}$ performed significant increase EO% by 6, 4, 3% over control at NPK application, respectively that exceeded to 8, 6, 5% over control, respectively at MLE application, also, $Z_{2\text{-}4}$, increased significantly EO% by 7, 9, 10% of control at NPK that exceeded to 9, 11, 12% over control at MLE application, respectively.

Table 1. Gamma irradiation and/ or nano. Zinc Impacted as elicitors on plant height, Cm and fresh herb yield/ plant, g. for Baselplantsfertilized by NPK, MLE

	Plant heigh,cm								Fresh herb yield, g. / plant							
	1 sty cut		2ad cut		3rdcut		Pooled3 cuts		1st cut		2 ND cut		3 rd. cut		Pooled3 cuts	
Elicitor	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE
G_1Z_1 Control	41.6(100)	42.8 (3)	45.3 (100)	46.7 (3)	53.7(100)	55.3 (3)	140.6(100)	144.8(3)	341.1(100)	348.0(2)	375.2(100)	382.8(2)	420.7(100)	429.2(2)	1137.0(100)	1160.0(2)
G_2	45.1(7)	45.6(8)	485 (7)	48.6 (8)	57.2 (7)	58.0 (8)	150.4(7)	151.8(8)	361.6(6)	368.4(8)	397.7(6)	405.2(8)	445.9(6)	454.3(8)	1205.0(6)	1227.9(8)
G_3	44.3(5)	44.7 (6)	47.2(5)	47.7(6)	56.1(5)	56.6 (6)	147.6(5)	149.0(6)	351.3(3)	358.1(5)	386.5(3)	394.0(5)	433.3(3)	441.7(5)	1171.1(3)	1193.8(5)
G_4	43.5(3)	44.5 (4)	46.7 (3)	47.7(4)	55.3(3)	55.5(4)	144.8(3)	164.2(4)	348.0(2)	354.8(4)	382.7(2)	390.2(4)	429.1(2)	437.5(4)	1159.8(2)	1182.5(4)
Z_2	54.6(8)	46.0(9)	48.9 (8)	49.4 (9)	57.7 (8)	58.2 (9)	151.8(8)	153.3(9)	354.8(4)	361.6(6)	390.2(4)	397.7(6)	437.5(4)	445.9(6)	1182.5(4)	1205.2(6)
Z_3	44.7 (6)	45.1(7)	47.7(6)	48.1 (7)	56.6 (6)	57.2 (7)	149.0(6)	150.4(7)	358.1(5)	365.0(7)	394.0(5)	401.5(7)	441.7(5)	450.1(7)	1193.8(5)	1216.6(7)
Z_4	43.9 (4)	44.3(5)	46.8(4)	47.2(5)	55.5 (4)	56.1(5)	146.2(4)	147.6(5)	368.4(8)	375.2(10)	405.2(8)	412.7(10)	454.4(8)	462.8(10)	1228.0(8)	1250.7(10)
G_2Z_2	47.3 (12)	48.5(15)	50.4 (12)	51.8 (15)	59.8 (12)	61.4 (15)	157.5(12)	161.7(15)	392.3(15)	399.1(17)	431.5(15)	439.0(17)	433.8(15)	492.2(17)	1307.6(15)	1330.3(17)
G_2Z_3	48.1(14)	48.9 (16)	51.3 (14)	52.2 (16)	60.9 (14)	62.0 (16)	160.3(14)	163.1(16)	402.5(18)	409.3(20)	442.8(18)	450.3(20)	496.4(18)	504.8(20)	1341.7(18)	1364.4(20)
G_2Z_4	48.9(16)	49.8 (18)	52.2(16)	53.1(18)	62.0 (16)	63.4(18)	1361(16)	165.9(18)	412.8(21)	419.6(23)	454.0(21)	461.5(23)	509.0(21)	517.4(23)	1375.8(21)	1398.5(23)
G_3Z_2	64.4(10)	47.3(12)	49.5 (10)	50.4(12)	58.8(10)	59.8 (12)	145.7(10)	157.5(12)	385.4(13)	388.8(14)	424.0(13)	427.8(14)	475.4(13)	479.6(14)	1284.8(13)	1296.2(14)
G_3Z_3	46.8(11)	47.7(13)	50.0 (11)	50.8 (13)	59.3 (11)	60.4(13)	156.1(11)	158.9(13)	395.7(16)	402.5(18)	453.2(16)	442.8(18)	488.0(16)	496.4(18)	1318.9(16)	1341.7(18)
G_3Z_4	47.7(13)	48.9 (16)	50.8(13)	52.2(16)	60.4(13)	62.0 (16)	158.9(13)	163.1(16)	405.9(19)	409.3(20)	446.5(19)	450.3(20)	500.6(19)	504.8(20)	1353.0(19)	1364.(20)
G_4Z_2	46.4 (10)	468(11)	49.5 (10)	50.0(11)	58.8 (10)	59.3 (11)	154.7(10)	156.1(11)	378.6(11)	385.4(13)	416.5(11)	424.0(13)	467.0(11)	457.4(13)	1262.1(11)	1284.8(13)
G_4Z_3	46.0 (9)	47.3(12)	49.1(9)	50.4(12)	58.2 (9)	59.8(12)	153.3(9)	157.5(12)	388.8(14)	399.1(17)	427.8(14)	439.0(17)	479.6(14)	492.2(17)	1296.2(14)	1330.3(17)
G_4Z_4	46.2(11)	43.9 (14)	49.3(11)	64.8(14)	58.6 (11)	55.5 (14)	154.1(11)	146.2(14)	382.0(12)	392.3(15)	420.2(12)	431.5(15)	471.2(12)	483.8(15)	1273.4(12)	1307.6(15)
LSD%	0.2		0. 3		0.4		0.7		1.5		2.3		2.7		5.3	

G_{1-4}were: $_{0,25,50,75}$Gy, respectively.
Z_{1-4}were: $_{0,30,50,80}$ppb, respectively.
Values between parenthis were percent over control.

Table 2. Gamma irradiation and / or Nano-zinc impacted dry herb Biomass,g/m2,essential oil% (EO%) and essential oil yield, g/m2 for Basel Plants fertilized by Moringaleaves extract and NPK

	DHB,g/m^2		EO%		EOY,g/M^2	
Elicitor						
	NPK	MLE	NPK	MLE	NPK	MLE
G_1Z_1 0 control	456.9 (100)	470.6 (3.0)	0.411 (100)	0.428 (4.0)	187.8 (100)	201.4 (7.0)
G_2	488.9 (7.0)	493.5 (8.0)	0.436 (6.0)	0.444 (8.0)	213.2 (14.0)	219.2 (17.0)
G_3	475.2 (4.0)	479.8 (5.0)	0.428 (4.0)	0.436 (6.0)	203.4 (9.0)	209.2 (11.0)
G_4	470.2 (3.0)	475.2 (4.0)	0.423 (3.0)	0.432 (5.0)	199.1 (6.0)	205.3 (9.0)
Z_2	479.8 (5.0)	484.3 (6.0)	0.440 (7.0)	0.448 (9.0)	211.1 (13.0)	216.9 (16.0)
Z_3	484.3 (6.0)	488.9 (7.0)	0.448 (9.0)	0.456 (11.0)	216.9 (16.0)	222.9 (19.0)
Z_4	498.0 (9.0)	502.0 (10.0)	0.452 (10.0)	0.460 (12.0)	225.1 (19.0)	321.1 (23.0)
G_2Z_2	525.4 (15.0)	530.0 (16.0)	0.468 (14.0)	0.477 (16.0)	245.9 (30.0)	252.8 (34.0)
G_2Z_3	543.7 (19.0)	548.3 (20.0)	0.477 (16.0)	0.481 (17.0)	259.4 (38.0)	263.8 (40.0)
G_2Z_4	557 (22.0)	566.6 (24.0)	0.489 (19.0)	0.506 (23.0)	272.6 (45.0)	286.7 (52.0)
G_3Z_2	520.9 (14.0)	525.4 (15.0)	0.461 (12.0)	0.473 (15.0)	240.2 (27.0)	248.5 (32.0)
G_3Z_3	534.6 (17.0)	539.2 (18.0)	0.473 (15.0)	0.477 (16.0)	252.9 (34.0)	457.2 (36.0)
G_3Z_4	539.2 (18)	543.7 (19.0)	0.481 (17.0)	0.485 (18.0)	259.4 (38.0)	263.7 (40.0)
G_4Z_2	511.7 (12.0)	520.9 (14.0)	0.465 (17.0)	0.469 (14.0)	237.9 (26.0)	244.3 (30.0)
G_4Z_3	516.3 (13.0)	530.2 (16.0)	0.369 (14.0)	0.473 (15.0)	242.2 (28.0)	250.7 (33.0)
G_4Z_4	530.0 (16.0)	534.6 (17.0)	0.473 (15.0)	0.481 (17.0)	250.7 (33.0)	257.2 (36.0)
LSD%	1.3		0.003		1.5	

G_{1-4} were: $_{0,25,50,75}$Gy, respectively.
Z_{1-4}were: $_{0,30,50,80}$ppb, respectively .
Values between parent his were percent over control.

Integrated G_{2-4} with Z_{2-4} actuated synergistic significant increments ranged 12-19% for NPK exceeded to 14-23% for MLE application Further G_2Z_4. showed excel range 19, 23 for NPK and MLE, respectively (Table $_2$,Figure $_2$).

Essential yield, g/m^2 (EOY, g/m^2): EOY g/m^2. 187.8 for NPK application, increased significantly up to 201.4 due to MLE application which represented 7% over that NPK (Table $_2$).G_{2-4} resulted significant increase EO% 14, 9, 6% of control at NPK application and 17, 11, 9% of control at MLE application, respectively while Z_{2-4} also led to significant increase 13, 16, 19% over control at NPK application and 16, 19, 23% over control for NPK and MLE, respectively (Table $_2$).G_{2-4} integrated with Z_{2-4} acted significant synergistic positive

impacts (EOY, g/m^2)ranged 26-45%over control at NPK and 30-52% over control at MLE application, exceedingly, G_2Z_4 showed the best application treatment 45, 52% of control for NPK and MLE, respectively (Table $_{2}$, Figure 3).

Essential oil contents (EOC): The main chemical components for Basil EO were, methyl- chavicole%, linolool. %euggenol % geraniol% Linaly%Total contanant significance-positive impacted with MLE>NPK application MLE acted

Table 3. Gamma irradiation and / or Nano-zinc as elicitor actuated essential oil content on Basel plantsfertilized with NPK and MLE

	% EOcontant											
	Methyl-chavicol%		Linalool%		Euggenol%		Geraniol%		Total contant		Linaly%	
Elicitor	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE
G_1Z_1 0 control	22.031	22.692	12.075	12.437	9.254	9.624	0.126	0.134	0.652	0.691	44.148	45.578
	(100)	(3.0)	(100)	(3.0)	(100)	(4.0)	(100)	(6.0)	(100)	(6.0)	(100)	(3.0)
G_2	23.133	24.508	12.678	13.432	9.532	10.298	0.129	0.148	0.678	0.754	46.150	49.140
	(5.0)	(8.0)	(5.0)	(8.0)	(3.0)	(7.0)	(2.0)	(8.0)	(4.0)	(9.0)	(4.6)	(11.0)
G_3	22.912	24.280	12.558	13.308	9.439	10.202	0.130	0.144	0.672	0.746	45.711	48.670
	(4.0)	(7.0)	(4.0)	(7.0)	(2.0)	(6.0)	(3.0)	(7.0)	(3.0)	(8.0)	(3.6)	(10.0)
G_4	22.692	24.054	12.438	13.184	9.346	10.106	0.127	0.142	0.665	0.740	45.268	47.628
	(3.3)	(6.0)	(3.0)	(6.0)	(1.0)	(5.0)	(1.0)	(6.0)	(2.0)	(70)	(2.6)	(8.0)
Z_2	23.133	24.620	12.714	13.432	9.365	10.394	0.130	0.145	0.667	0.749	46.009	49.340
	(5.0)	(8.5)	(5.3)	(8.0)	(1.2)	(8.0)	(3.2)	(8.2)	(4.2)	(8.3)	(4.0)	(12.0)
Z_3	23.352	24.734	12.779	13.557	9.550	10.316	0.131	0.146	0.674	0.755	46.486	49.508
	(6.0)	(9.0)	(6.0)	(9.0)	(3.2)	(7.2)	(4.0)	(9.0)	(3.5)	(9.3)	(5.0	(12.0)
Z_4	23.574	24.692	13.041	14.915	9.624	10.134	0.133	0.149	0.684	0.767	47.056	50.567
	(7.o)	(10.0)	(8.0)	(11.0)	(4.0)	(5.3)	(5.0)	(11.0)	(5.0)	(11.0)	(7.0)	(14.6)
G_2Z_2	23.352	24.258	12.859	13.606	9.578	10.586	0.132	0.146	0.688	0.760	46.609	49.356
	(6.5)	(9.6)	(6.5)	(9.4)	(3.5)	(10.0)	(4.4)	(29.3)	(5.0)	(10.0)	(6.0)	(12.0)
G_2Z_3	23.463	25.974	12.920	13.706	9.716	10.490	0.133	0.147	0.692	0.774	64.924	50.191
	(7.7)	(10.5)	(7.0)	(10.2)	(5.7)	(9.0)	(5.5)	(10.0)	(6.0)	(12.0)	(6.3)	(14.0)
G_2Z_4	24.014	25.415	13.405	14.178	9.902	1o.414	0.134	0.150	0.697	0.780	48.151	50.937
	(9.0)	(12.0)	(11.0)	(14.0)	(7.0)	(8.2)	(6.0)	(12.0)	(7.0)	(13.0)	(9.0)	(16.0)
G_3Z_2	24.675	26.096	13.766	14.552	9.856	10.616	0.138	0.154	0.710	0.794	49.145	52.212
	12.0)	(15.0)	(14.0)	(17.0)	(6.5)	(10.3)	(9.0)	(15.0)	(9.0)	(15.0)	(11.4)	(16.0)
G_3Z_3	24.234	25.710	13.282	14.054	9.670	10.682	0.136	0.153	0.700	0.782	48.022	51.381
	(10.0)	(13.3)	(10.0)	(13.0)	(4.5)	(11.0)	(8.0)	(14.0)	(7.3)	(13.2)	(9.0)	(16.0)
G_3Z_4	24.014	25.415	13.405	14.178	9.902	10.414	0.134	0.150	0.697	0.780	48.151	50.937
	(9.0)	(12.0)	(11.0)	(14.0)	(7.0)	(8.2)	(6.0)	(12.0)	(7.0)	(13.0)	(9.0)	(16.0)
G_4Z_2	23.706	25.029	12.968	13.742	9.588	10.827	0.132	0.148	0.682	0.764	49.145	52.212
	(7.6)	(10.3)	(7.4)	(10.5)	(3.6)	(12.5)	(4.7)	(10.4)	(4.5)	(10.5)	(11.4)	(18.3)
G_4Z_3	24.344	25.800	13.282	14.078	9.688	10.682	0.134	0.151	0.701	0.784	47.076	50.510
	(10.5)	(13.7)	(10.0)	(13.2)	(4.7)	(11.0)	(7.0)	(13.0)	(7.5)	(13.5)	(6.7)	(4.4)
G_4Z_4	24.454	25.982	13.404	14.178	9.948	10.422	0.138	0.154	0.705	0.789	48.149	51.495
	(11.0)	(14.5)	(11.0)	(14)	(7.5)	(8.3)	(9.5)	(15.0)	(8.0)	(14.5)	(9.1)	(16.7)
LSD											0.015	

$G_{1\text{-}4}$were: $_{0,25,50,75}$Gy, respectively.
$Z_{1\text{-}4}$were: $_{0,30,50,80}$ppb, respectively.
Values between parent his were percent over control.

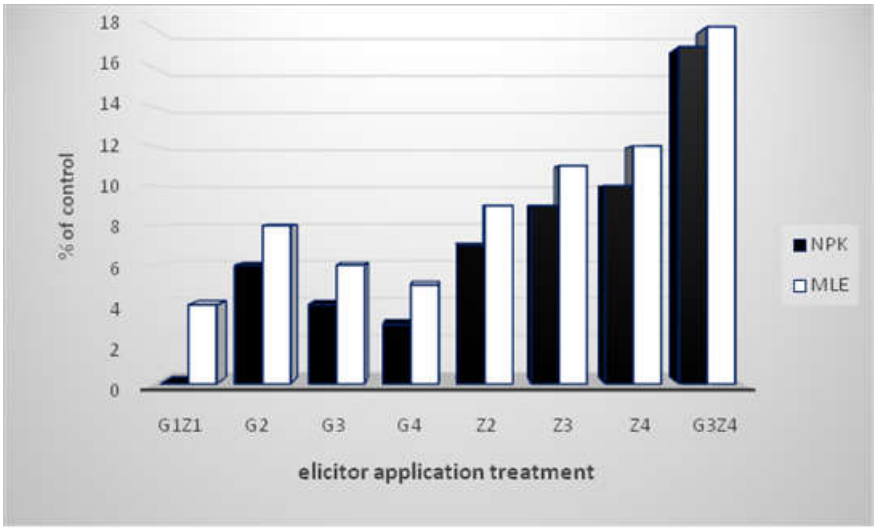

Figure 2. Essential oil %

sum, 5 main EO content by significant 3% increment over that NPK application (Table $_2$). Sole G, Z performed significant positive impact for sum 5 main EOcontent aside Z> G. whereas, Gintegrated with Z resulted in Synergistic significant positive impact in sum 5 main content of EOup to 11.4, 18.3% for G_2Z_4 at NPK,MLE, respectively (Table $_2$).

Total phenolic content (TPC): Table (4), represented that TPC, mg Gallic acid equitant content (TPC, mgGA/g-&.w), showed significantincrease up to 3% under MLE over NPK application $G_{2,3,4}$ actuated significant in crease 7,6, 5% of control at MLE and 5,4,3%of control at UPK application, respectively.

Table 4. Elicitation With gamma irradiation, and / or Nano-zinc as elicitors impacts on Secondary Metabolites for Basel plants fertilized with NPK and MEL

	TPC		TFOC		Quercetin		Kaempferol		Rutin	
	(mgGAE/g.d.w)		(mgCE/gd.w)		(mgGAE/g.d.w)		(mgGAE/g.d.w)		(mgGAE/g.d.w)	
Elicitor	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE	NPK	MLE
G_1Z_1 0 control	48.25	52.11	22.32	23.44	2.68	2.76	1.73	1.80	1.16	1.25
	(100)	(8)	(100)	(5)	(100)	(3)	(100)	(4)	(100)	(8)
G_2	50.66	51.63	23.66	24.10	2.86	2.89	1.88	1.90	1.25	1.30
	(5)	(7)	(6)	(8)	(7)	(8)	(9)	(10)	(8)	(12)
G_3	50.18	51.14	23.21	23.66	2.82	2.84	1.85	1.82	1.21	1.25
	(4)	(6)	(4)	(6)	(5)	(6)	(7)	(5)	(4)	(8)
G_4	49.601	50.66	22.98	23.44	2.78	2.82	1.82	1.85	1. 19	1.24
	(3)	(5)	(3)	(5)	(4)	(5)	(5)	(7)	(3)	(7)
Z_2	52.11	52.59	24.99	25.44	2.84	2. 86	1.87	1.92	1.27	1.28
	(8)	(9)	(12)	(14)	(6)	(7)	(8)	(11)	(10)	(11)
Z_3	53.08	54.04	25.67	26.12	2.92	2.95	1.88	1.90	1.30	1.35
	(10)	(12)	(15)	(17)	(9)	(10)	(9)	(10)	(12)	(14)
Z_4	53.56	54.52	26.78	27.23	2.97	3.00	1.90	1.94	1.34	1.38
	(11)	(13)	(20)	(22)	(11)	(12)	(10)	(12)	(15)	(19)
	57.9	58..38	27.90	28.79	3.05	3.11	2.07	2.16	1.45	1.49
G_2Z_2	(20)	(21)	(25)	(29)	(14)	(16)	(20)	(25)	(25)	(29)
	58.86	59.35	28.35	29.01	3.10	3.14	2.25	2.34	1.56	1.56
G_2Z_3	(22)	(23)	(27)	(30)	(16)	(17)	(30)	(35)	(35)	(42)
	60.32	61.67	30.13	30.58	3.18	3.29	2.46	2.51	1.69	1.72
G_2Z_4	(25)	(28)	(35)	(37)	(19)	(23)	(42)	(45)	(46)	(48)
	55.00	55.97	27.23	27.67	3. 00	3.08	1.99	2.11	1.39	1.44
G_3Z_2	(14)	(16)	(22)	(24)	(12)	(15)	(15)	(22)	(20)	(24)
	56.45	57.42	28.12	28.57	3.11	3.14	2.18	2.22	1.43	1.74
G_3Z_3	(17)	(19)	(26)	(28)	(16)	(17)	(26)	(28)	(23)	(27)
	57.9	58.86	29.24	29.68	3.16	3.19	2.28	2.38	1.54	1.56
G_3Z_4	(20)	(22)	(31)	(33)	(18)	(19)	(32)	(38)	(33)	(35)
	55.48	56.45	27.00	27.45	3.03	3.05	1.97	2.06	1.454	1.48
G_4Z_2	(15)	(17)	(21)	(23)	(13)	(14)	(14)	(19)	(25)	(28)
	55.97	56.93	27.90	28.34	3.08	3.11	2.11	2.16	1.47	1.50
G_4Z_3	(16)	(18)	(25)	(27)	(15)	(16)	(22)	(25)	(27)	(29
	56.93	57.90	28.79	29.01	3.14	3.16	2.19	2.23	1.51	1.53
G_4Z_4	(18)	(20)	(29)	(30)	(17)	(18)	(29)	(29)	(30)	(32)
LSD 1 %	0.2		0.13		0.04		0.02		0.03	

$G_{1\text{-}4}$were: $_{0,25,50,75}$Gy, respectively.
$Z_{1\text{-}4}$were: $_{0,30,50,80}$ppb, respectively
Values between parent his were percent over control.

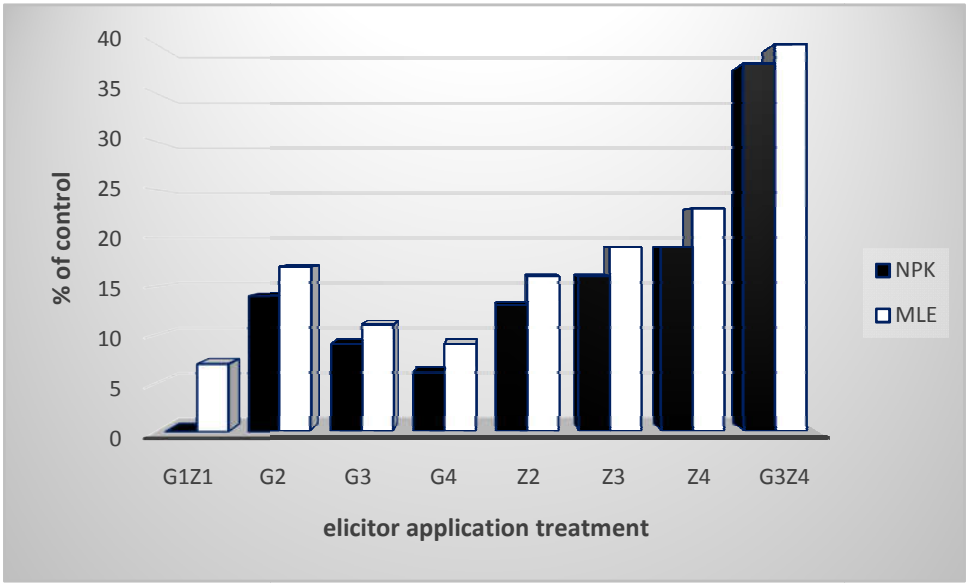

Figure 3. Essential oilyield,g/m^2

Also, $Z_{2, 3, 4}$ invoked significant increase 9, 12, 13% of control at MLE and 8, 10, 11% of control at NPK, respectively. Whilst $G_{2\text{-}4}$ integrated with Z2-4 exhibited synergistic significant positive impact ranged 16-28, 12-25% of control for MLE and NPK, respectively aside G_2Z_4excite the best integrated application (Figure 4).

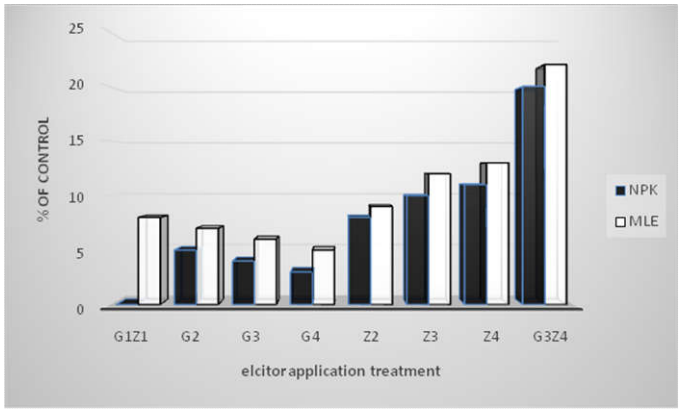

Figure 4. Total phenolic content, mg Gallic acid .equivalent/g.d.w

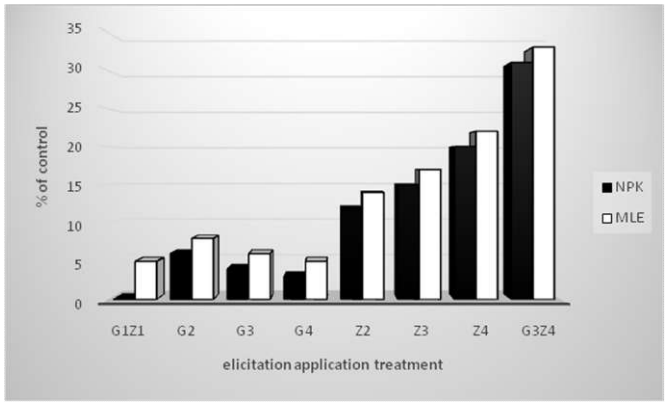

Figure 5. Total flavonoids content, mg catechin equivalents/g.d.w

Flavonoidsidentification(FI): Quercetin, kaempferol and rutin, that were identified from flavonoids, were increased 3,4,8% at MLE over that of NPK application.at zero controlwhereas, $G_{2,3,4}$ achieved significant increase (8, 6,5%), (10,5,7%), (12,8,7%), of control at MLE and(7,5,4%), (9,7,5%),(8,4,3%) of control at NPK for quercetin, kaemplferol and rutin, respectively. At that, $Z_{2,3,4}$ also resulted in significant increase (7,10,12%), (11, 10, 12%), (11,14,19%) of control at MLE and (6,9,11%) (8,9,10%), (10,12, 15%) of control at NPK application, respectively (Table $_4$Figure$_4$). Concerning $G_{2\text{-}4}$ integrated with $Z_{2\text{-}4}$achieved synergistic significant positive impact ranged (14-23%), (19-45%), (24-48%) of control at ML Eapplication whereas at NPK were (13-19%), (14-42%), (20-46%) of control for quercetin, kaempferol and rutin,respectively. Exceedingly, G_2Z_4exhibited the best integratedapplication (23,45,48%) of control atMLE and (19,42,46%) of control atNPK, respectively (Table 4). respectively.

DISCUSSION

At G_1, Z_1, MLE resulted significant positive impact as percent of NPK for growth (3PH, 2FH, g/P), Biomass (3DHy,g/m^2), SMs (4EO%, (7EOY, g/m^2,)chavicole,3%linolool. %euggenol ,6%geraniol 6%Linaly 3% Total continentiutin). Thefore: MLE potent meliorate SB biomass production and quality asbiofertilizer and organic elicitor. These findings were in line and confirmedrecently (78-82). Elicitation with sole, (G) or (Z) invoked significant positive impact growth biomass SMs production and quality under MLE over NPK.whereas, Gintegrated with Z achieved synergistic significant positive impactaside under MLE exceeded significantly under NPK. These findings owingto Nano- particles, abiotic and biotic elicitors can have beneficial effects onmorphological physiological characteristics that led to enhance herbagemorphological physiological characteristics that led to enhance herbagebiomass and BSMs production and quality (83-86,51).At that elicitors promoted growth and accelerated SMs accumulation byregulating the expression of the metabolite biosynthesis related genes (87,88,82).

Conclusion

Overall, the results emphasis to recommend solitary-elicitation with low gamma irradiation dose (G) or nano- zinc oxide (Z) under Moringa leaves extract (MLE) as biofertilizer or conventional chemical (NPK) fertilizer; significantly promoted growth, appraising biomass, bioactive secondarymetabolites production and quality for Basil (*Ocimumbasilicum*). Whereas, Integrated (GZ)achieved synergetic significant responses, aside (G), (Z), (GZ) under (MLE) exceeded significantly (NPK). Therefore, highlight biofertilizer (MLE) that could be substituteconventional chemical fertilizer conrporated with reliableelicitation with G , Z, or GZ, in attainingappraisement biomass yield and main health- promoting secondary metabolites.

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