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RESEARCH ARTICLE

ENVIRONMENTAL CHANGES AND PLANT TAXONOMY

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ABSTRACT

Environmental changes have been greatly affecting the phenotypic and genotypic characters of plant. These environmental changes affect, as well, the static magnetic force on the Earth which in turn changes the habitats and the taxonomical and physiological characters of the plants. Type of vegetation and species forming communities will be changed and allowed invaded species to compete the local ones. All of these variables beside the variations in climatic and human behavior happened after Covid 19 alters the genetic, taxonomic and phenatic characters of the species and consequently change their taxonomic status. Thus plant taxonomy has to modulate in order to face all these variables and move to new era in classification in response to ecological variables.

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INTRODUCTION

Plants are the only autotrophic creature on the Earth. These plants give the life to all other organisms. Not only as source of food, but also it has many components that can be of use in medicinal treatments. Some other plants are harmful to humans, but it can be used for shelter manufacture and many other sorts of use. For that, identification of these plants and the careful investigations about their components are essential. Plant taxonomy is the branch of science which deals with this job. Careful study of the plants and clear taxonomic relations can help in getting maximum benefit from them. Unfortunately, our planet is in continuous change, this affects the vegetation, biodiversity and even the characteristic features of the plants themselves and in severe cases it may arise in emerging new species and extinction of other ones. Climatic changes have its role in the alteration of the soil characters and even water availability which in turn affects the morphological and chemical characters of the species. These variations may be insignificant and in this case taxonomists consider these individuals as ecotypes, or phenotypic variations or it become more serious to change the gene pool and give up new species. Radford (1986) stated that ` evidence from plant morphology provided the basic language for plant characterization, identification, classification and relationships`. Accordingly, vegetative and floral morphological characters were the first steps in taxonomical decisions.

There are many causes for these environmental changes; people's behavior is one of these causes. Tilman and Lehman (2001) pointed to the disaster of up use in the rate of supply of the major nutrients that constrain the productivity, composition, and species diversity of terrestrial ecosystems. They pointed to more dangerous results of human behavior as it may cause global species extinction and direct habitat destruction. Their behavior can affects the natural rates of nitrogen addition and phosphorus liberation to terrestrial ecosystems as well as atmospheric CO_2. These environmental changes have been reflected by constantly shifting vegetation beside the type of species forming communities (Huntley, 2005; Dunlop & Brown, 2008). Thus, environmental changes happened in our planet now a day, will alter the characteristic features of the known species we have. The climate change happened in the last decades affects the temperature, rainfall, CO_2 as well as the concentrations of the air gases. All of these have their effect on the magnetic force on the Earth. These in turn changed the phenotypic and physiological characters of plants and end with the alteration of their taxonomic characters and position (Taia, 2006; Taia & Kootbi, 2007 and Taia *et al.*, 2005 & 2007). Now a day the Earth faces new disaster, CORONA Virus (Covid-19) and its effect on both people attitude, climate, air gas contents and all environmental conditions. We have to think in the future of our planet, to where we are going and what the future of our planet is.

Covid-19, environment and plant taxonomy: Viner *et al.* (2020) and WHO (2020) announced in March 2019 that the CORONA virus disease is pandemic disease, which generates

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major challenges for society, education, research works, human behavior and medical supports. As we mentioned before in response to Baldini (2020) view, this virus affects the systematic works, field trips and herbarium collections. Peoples became worried to communicate and to go collecting plant specimens and even go to laboratory examinations. Cota-Sánchez (2020) has his own view in this concern replying to Baldini queries. He suggests to return to our old systems and traditional taxonomy. Accordingly we have to overlook briefly the history of plant taxonomy and see how the progression in plant taxonomy was correlated with environmental changes, people thinking, invention of new instruments and techniques beside the historical changes in the world, now we have to think and ask what the next step is?. Plant taxonomy has been passed by six periods from the folk taxonomy, artificial, natural, phylogenetic, numerical and molecular studies (Taia, 2005). Each of these periods has its own thinking, feature and promotions. In the time being and after Covid-19 we have to stop and think where we will go in the science of plant taxonomy? Covid-19 caused great alteration in the environment and peoples which in turn affects on all living organisms, especially plants. Every day, there are many reports about how much our environment has been changed and our planet in a continuous alteration by the socio-ecological interactions. Al-Khashman (2020) has an opinion about the effect of Corona virus and the recovery of the environment. He pointed to the restoration of the ozone layer and decrease of air and water pollution. Pearson *et al.* (2020) mentioned that this virus has changed greatly human behavior which decreases pollution and this can be of benefit on biodiversity. Baldini (2020) has his expectation about the complications which will face the taxonomists in the field due to the pandemic of Corona virus, the difficulty in travelling, collecting data and specimens, visiting herbaria and field courses. He wonder if plant taxonomy branch can accommodate with the changes happened in both the environment and human behavior after Covid -19. In fact within these two years, the plants morphological and Phenological features have been changed and need to more investigations and breeding experiments to evaluate how much these changes affect the species. Flowering times, color of the flowers and their life periods have been obviously changed. In addition to the changes in the vegetative morphological characters, especially the leaves, led to misidentification of the species.

Environmental changes and its effect on plants: Environmental factors are concept that includes all the factors affecting any organism and the term environment also among the basic terms used in ecology. Any organism has its own environmental factors that enable him to survive. Walter and Schurr (2005) indicated that higher plants respond to the environmental changes through the modification and alterations in their morphology and internal Tissues. Most of the studies on the effect of the environmental factors on plants were dealing with temperature, precipitations, soil and minerals. Others dealt with the effect of urbanization and human activities on the biodiversity and distribution. Tilman and Lehman (2001) pointed to the effect of anthropogenic activities on the main resources for plants which led to the change in plant diversity, populations, distribution and densities. They expected that the rapid environmental changes happened are due to human actions. Actually, human behavior affects the environment to great extent even climate changes and cause air pollutions. Sahney *et al.* (2010) and Dadamouny and Schnittler (2016) warned from future disorders and rapid climate change on current plant diversity patterns in response to these changes and environmental disorders. Chapin *et al.* (2000) pointed to the disaster of mass extinction similar to the Holocene extinction (sixth mass extinction) as a result of human actions. Another point considering adaptation of native species in response to the environmental changes resulting alteration in the genetic composition over generations (Lajoie and Vellend, 2018). This genetic alteration called isolation by environment (IBE) independent of geographic distance as explained by Sexton *et al.* (2013) and Wang and Bradburd (2014). In response to the changes in the environmental factors, the plants change their morphological characters gradually, and this is the first noticeable thing and what we called phenotypic plasticity. The phenotypic plasticity includes changes in the metabolism of plants and transferred into the acid metabolism of Crassulaceae (CAM). These plants which have CAM can tolerate both water and temperature stresses by opening their stomata at night to capture CO_2 and photosynthesis occurs during the day through photochemical effects of the solar radiation while the stomata remain closed (Luttge, 2010). Nicotra *et al.* (2010) warned from the effect of climate changes on plants, as it will fasten the phenotypic plasticity.

These studies concern mainly the responses of plants to drought, climatic and human activities, each separately. Another important alteration in the plants responding to the environmental changes is the timing of phenological events, such as flowering and fruiting times in response to temperature changes as recorded by Parmesan and Yohe (2003). Fitter and Fitter (2002) found that the flowering times in British plants have changed in response to ecological consequences, leading to annual plants flowering prior than perennials, and insect pollinated plants flowering earlier than wind pollinated plants. But in this situation with the great effect of Covid-19 on both human activities and climatic factors, the phenological time of most road trees has been noticeably changed and we don`t expect what is the next?.

As the result of the great morphological and reproduction behavior changes in the existing species, gene alterations and new species may arise. Meanwhile the local vegetation will change greatly beside new species will invade the present communities. The result of the lockdowns and restrictions in travelling, industrial activities and movement around the world to control COVID-19, resulted in a drop in daily global carbon emissions of 17 percent in April as mentioned by Cho (25 June, 2020). In spite of that the CO_2 level in the atmosphere is very high, but it may have an effect on the plant. All of these, beside others, will affect the taxonomic characters of the species. Consequently the branch of taxonomy will move to another seventh period and taxonomists have to alter their traditional thinking and examine the present taxa more carefully with the respect of the new variables.

Habitat variations and its effect on plants: growing in three different habitats, to investigate how much the habitats affect the morphological features of these species. Meanwhile color of the plants, density of the lateral branches, and time of fruiting stage has been altered within the three habitats (Table 1).

Table 1. Characters Studied and their status in the three different habitats in Saudi Arabia (after Taia and El-Olayan, 2003)

	El-Nargis district			El-Riyadh- El-Kharj			Wadi Hanifa		
Sp.→ Char.↓	*F.crispa*	*Z.spin.*	*R.vesi.*	*F.crispa*	Z.spni.	*R.vesi.*	*F.crispa*	*Z.spin.*	*R.vesi.*
Density	3	3	3	1	1	2	2	2	1
Appearance	1	2	3	1	2	2	3	3	1
Sh.Syst.L.	20-30	70-85	10-22	40-62	65-72	10-15	80-110	95-150	6-10
Color	1	2	2	1	2	2	3	4	4
Branches	2	2	2	2	3	2	4	4	1
Leaf color	3	1	3	3	1	3	3	4	2
Leaf marg.	2	1	1	3	1	1	2	1	1
Leaf apex	1	1	1	1	1	1	1	1	2
Leaf length	1.7-2.2 2.05	1.1-1.5 1.4	4.5-5.2 4.97	2.2-2.5 2.38	1.6-2.3 2.05	3.0-4.0 3.2	2.0-2.2 2.14	1.5-1.8 1.61	2.5-4.0 3.2
Leaf width	0.3-0.4 0.38	0.2-0.3 0.27	2.5-2.9 2.75	0.3-0.5 0.42	0.3-1.0 0.6	2.0-3.5 2.8	0.4-0.5 0.45	0.4-0.5 0.41	2.0-3.2 2.8
Leaf shape	1	1	3	1	2	4	1	1	4
Moisture	62.5	60.6	85.62	73.1	76.8	88.62	69.5	69.6	87.18
Fruit	0	2	2	0	1	1	0	1	0
Fruit shape	0	2	1	0	2	1	0	2	0

Characters : 1- Density 1= low, 2=moderate, 3=dence ; 2- Appearance 1=dry, 2=slightly flourished, 3=flourished; 3- Length of the shoot system in cm.; 4-Colour of the shoot system 1=whitish green, 2=green, 3=bright green 4=olive green; 5- Density of branches 1=unbranched, 2=branched, 3=densely branched, 4=very densely branched; 6-Leaf colour 1=pale green, 2=green, 3=olive green, 4=dark green; 7-Leaf margin 1=entire, 2=undulated, 3=sinuated; 8- Leaf apex 1=acute, 2=rounded; 9- Leaf length in cm.; 10- Leaf width in cm.; 11- Leaf shape 1=lanceolate, 2=ovate-lanceolate, 3=obovate, 4=broadly-obovate ; 12-Plant moisture content (percentage) ; 13=Fruit 0=absent, 1=present, 3=dense ; 14- Fruit shape 0=absent, 1=flat,2=globular.

Table 2. Measurements and status of the taxonomical characters (Taia and Kotby, 2007)

Char↓		Magnetic direction→ Magnetic forces→ Control↓ 0.002 ml.T.	Above soil surface		At soil surface			Under soil surface		
		0.42 ml.T.	0.38 ml.T.	0.22 ml.T.	1.42 ml.T.	0.78 ml.T.	0.36 ml.T.	0.71 ml.T.	0.44 ml.T.	0.35 ml.T.
1	16.34 ±0.21	14.0 ±0.48	21.78 ±0.51	26.5 ±0.42	30.54 ±0.52	22.9 ±1.12	34.8 ±0.93	25.06 ±1.02	25.84 ±0.3	18.56 ±0.71
2	2	1	1	1	1	3	1	2	2	3
3	1	1	2	2	1	2	2	2	2	2
4	2	1	2	1	1	1	2	1	1	1
5	1	2	1	2	2	2	2	1	2	2
6	43.26 ±0.97	39.74 ±0.86	43.92 ±0.61	45.76 ±1.36	38.64 0.22±	32.10 1.09±	44.62 0.53±	33.70 0.41±	30.40 0.51±	26.56 **±0.34**
7	2.65 ±0.07	2.86 ±0.13	2.02 ±0.04	1.73 ±0.06	1.27 ±0.03	1.43 ±0.09	1.29 ±0.03	1.35 ±0.05	1.18 ±0.02	1.44 ±0.06
8	2	2	2	2	1	1	1	2	1	1
9	2	4	6	6	7	8	10	5	3	3
10	2	1	2	2	2	1	2	1	1	1
11	2	1	1	1	2	2	2	2	2	2
12	1	1	1	1	1	1	1	1	2	2
13	73	65	90	121	98	103	112	77	52	60
14	1	1	2	2	2	1	2	3	3	3
15	5.18 ±0.09	5.94 ±0.04	6.20 ±0.2	7.1 ±0.24	4.87 ±0.12	5.94 ±0.04	5.70 ±0.30	5.30 ±0.25	4.80 ±0.12	4.40 ±0.24
16	2.10 ±0.04	4.14 ±0.01	4.16 ±0.10	4.92 ±0.09	4.06 ±0.15	3.06 ±0.04	4.04 ±0.16	3.36 ±0.10	2.82 ±0.18	2.48 ±0.02
17	2	2	2	2	2	1	2	1	1	1
18	1	1	1	1	1	2	1	2	2	2
19	1	1	1	1	1	2	1	1	2	2
20	2	1	2	2	1	1	1	1	2	2
21	2	1	3	3	1	1	1	1	2	2
22	1	2	2	1	2	1	1	2	3	3
23	0	1	1	3	5	4	10	3	2	1
24	10.4 0.80±	6.00 0.22±	9.70 0.58±	16.54 0.52±	16.00 0.67±	7.46 0.62±	15.72 0.50±	12.40 1.19±	9.98 0.57±	6.40 0.46±
25	1	1	2	2	1	2	1	2	2	2
26	1	2	2	2	2	1	2	2	2	2
27	1	1	2	2	3	1	1	3	2	3
28	3	1	1	1	2	1	1	3	1	3
29	18.84 ±0.034	----	----	----	18.82 ±0.36	----	----	19.01 ±0.62	----	16.83 ±0.62
30	21.84 ±0.034	----	----	----	18.82 ±0.36	----	----	21.41 ±0.47	----	19.65 ±0.38
31	1	2	2	2	2	1	2	2	2	2
32	0.78 ±0.35	0.52 ±0.13	0.78 ±0.13	0.82 ±0.09	0.80 ±0.32	----	0.69 ±0.02	0.83 ±0.32	0.67 ±0.12	0.81 0.21
33	0.45 ±0.21	0.28 ±0.02	0.46 ±0.06	0.45 ±0.18	0.49 ±0.21	----	0.49 ±0.13	0.42 ±0.05	0.52 ±0.08	0.42 ±0.12
34	1	1	1	1	1	----	2	1	3	2
35	2	1	1	1	1	----	2	1	1	2

1-length of primary root(cm.) 2- Morphology of primary root: - 1- Straight 2- Curved 3-Sinuate 3- Length of secondary root: 1= shorter than primary root 2= longer than primary root 4- Direction of secondary roots: - 1- Along the two sides 2- Lateral 5- Status of secondary roots:- 1- twining with the primary root 2- not so 6- Length of shoot system (cm.) 7- Ratio between 1ry root and shoot system lengths 8-Color of the stem:- 1- Green 2-Pinkish green 9- Number of lateral branches 10- Degree of hairiness on the stem:1- sparsely hairy 2- hairy 11- Type of hairs on the stem:- 1-non –glandular 2- glandular 12- Position of hairs on the stem:- 1- allover the stem 2- on the deep areas only 13-Total number of leaves in plants 14- Leaf color:1- bright green 2- green 3- olive green 15- Leaf length (cm.) 16-Leaf width (cm.) 17- Leaf shape: - 1- Ovate 2- Broadly-ovate 18-Leaf apex: - 1- Acute 2- Acuminate 19- leaf symmetry: - 1- Symmetric 2- Asymmetric 20- Leaf hairiness:- 1- Glabrous 2- Sparsely hairy 21- Type of hairs: - 1- Absent 2-Glandular 3- Non glandular 22- Leaf epidermal bladder 1= Absent 2= Present 3- Present in high density 23- Number of inflorescence / plant 24- Length of inflorescence(cm.) 25- Bract color: - 1- Green 2- Reddish 26- Presence of flowers inside the bract: - 1- Absent 2- Present 27- Pollen maturity: - 1-Absent 2- Immature 3- Mature 28- Pollen shape:- 1- Absent 2- Spherical 3- Sub-oblate 29- Pollen length(Um) 30-Pollen width (Um) 31- Presence of seeds:- 1-Absent 2- Present 32- seed length (mm.) 33-seed width (mm.) 34- seed shape:- 1- longitudinally elongated 2- ovate 3- rectangular 35- micropyle shape: 1-rouded 2- pointed.

Taia and El-Ghanem (2004) continued their observations on another five species widely distributed in different habitats in El-Riyadh city and they reach to the same conclusion, in spite of the differences in the mineral compositions in the individuals grown in the different habitat. Hassan *et al.* (2020) studied the effect of the edaphic and climate criteria on morphological, reproductive traits as well as phenolic and flavonoid metabolites in individuals of *Centaurea glomerata* Vahl grown in three populations found in different topographic features/habitat conditions along the Mediterranean coastal region of Egypt. They found that the individuals in the sandy habitats showed best morphological and reproductive features, whilst the opposite was true for that represented on the rocky hillside. Thus habitat variations induced alterations in the external morphological characters, as well as its chemical and mineral contents.

Global climate change and its complexities: The term climate refers to the long-term weather patterns within a defined region including temperature, humidity, wind, and amount and type of precipitation. This change happens over long period and led to the alteration of the whole ecosystem including both plants and animals. Global climatic changes represent from the greatest problems faced by all biologists. With global alterations in degrees of temperature and its variations between day and night, elevation of atmospheric CO_2 (eCO_2), and precipitation rates are all expected to impact plant distribution, physiology and interactions with other organism (Intergovernmental Panel on Climate Change (IPCC), 2014). Thomas *et al*. (2004) and Díaz *et al*. (2019) warned from the disorders in the ecosystem and loss of biodiversity as a result of the Anthropogenic Climate Change (ACC). Species can adapt with the new climates, and in this case the probability of its extinction will be omitted. In some cases the species realize that the original niche has been changed and start to either change its physiological and morphological appearance or chocked and disturb its physiological operations and end with its extinction or migrate to another more suiTable conditions. In both cases the phenotypic characters of the plant will changed and its correct identification will be difficult. Not only so, but also the changes in response to the climatic change may reach its anatomical structure and in certain cases will end in species isolations and disturb its breeding behavior. All of these consequences led to speciation and arise of new unknown species which confusing its identification, taxonomic characters and even position.

From the most important problems in the ACC are changing the geographical distribution of the species and changing the static magnetic forces on the Earth. Mackey (2007) wonder if climatic factors change in a region beyond the tolerance of a species, then distribution changes of the species may be inevitable. The species will shift to the latitude and altitude to adapt with the new conditions, meanwhile the morphological features of the species will alter in a phenomenon of phenotypic plasticity. In some cases these species cannot adapt with the new changes and extinct. In both cases the vegetation and the characters of the species will change leading to their misidentification and alteration in the local Floras. Cahill *et al.* (2013) mentioned how does climate change led to the extinction of the species responding to their distribution shift (Fig.1).

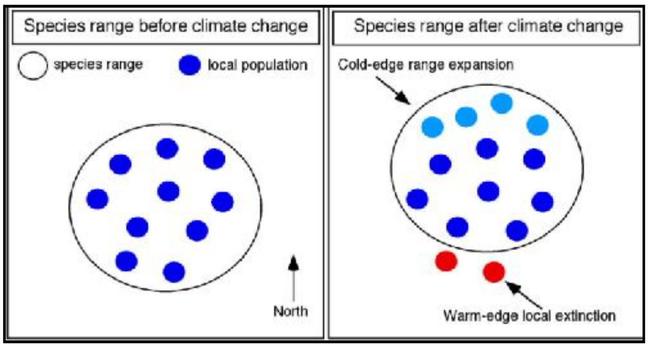

Fig. 1. Hypothetical example illustrating the two components of a geographical shift associated with climate change. The large open circle indicates the species overall geographic range. Small dark blue circles indicate populations before climate change. After climate change the overall geographic range is shifted northward (large open circle), both through the range expansion (new populations; small light blue circles) added at the northern cold edge of the species range and range contraction (local extinction of original populations; small red circles) at the southern , warm edge of the species range. Smaller patterns occur for ranges shifts along an elevation gradient (Cathill *et al.*, 2013)

Parmesan and Hanley (2015) warned from the severe effects of ACC on all the biological systems of plants in response to the change in temperature and water regimes. They noticed changing in the time of first flower appearance, seed dispersal as well as species geographical distribution. They expected general trend toward the poles and upward (altitudinal) range shifts. As a result of these changes the plant populations and the species constituent will change, beside their phenotype and biological activities will disturb which will end by changing the flora of each country and the taxonomic status of the species forming it. Parmesan and Hanley (2015) postulated proposals for research works in order to understand the responses of the plants to ACC as given in Fig.2. They summarized each item in few points, from which are the long term studies, especially on autumn delay, works on trophic synchrony and vernalization, better modeling of entire life cycles and studies on plant plasticity and their capacity to evolve and speciation.

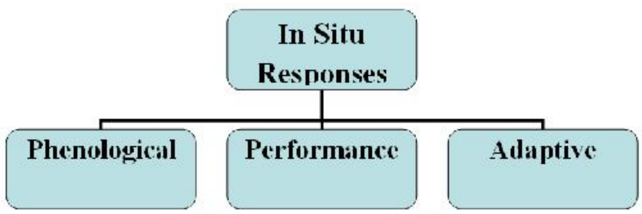

Fig. 2. Postulated proposals for research works in order to understand the responses of the plants to ACC (Parmesan and Hanley, 2015)

Invaded plants and its consequences in taxonomy: As mentioned above, climatic and environmental changes greatly affected the local vegetation and all the external and internal characters of the species. Habitat characters will alter in response to these changes giving chance to new invaders species to live and compete the native ones. Ghayal and Dhumal (2011) announced from the allopathic effect of invasive species on the whole ecosystem. Dadmouny (2009) and Dadamouny *et al.* (2012) pointed to the effect of these invaders in disturbing the physiological processes of the local species and the nutrient composition of the habitats.

In such case the original flora will be changed and even the adapted species will change their phenotypic characters. By the end, taxonomists must realize these changes and be very precise in taking decisions in upgrading or downgrading the original individuals or concerning them as new species. The original flora of each country has to be revising and the new species must be recorded and the species in danger must be genetically saved. Floristic works must develop with new thinking and consideration in response to environment.

Environment, Magnetism and Plant taxonomy: Magnetic forces have great effects on both plants and animals and even humans. These effects can be due to either the exposure to high intensity magnetic fields or to the lack of it. Unfortunately, the effects of magnetism are subtle and difficult to observe and this is the reason of why we lack information about it. Plants and animals use electromagnetic pulses or signals in communication, mating, warning, and protection. Pollen-seeking insects attracted to their flowers or their scent by means of these pulses. Before going to the different effects of this mysterious force, we have to remember that plants are the only creature that can make use of solar radiation during photosynthesis. Solar radiations themselves generate electromagnetic fields that can stimulate chemical reactions. Actually, this force is greatly affected by climatic and environmental changes. When we start talking about magnetic fields and plants, we must remember that all plants respond to the earth's gravity by growing up or down. This way of responding is called geotropism. But till 1980 a little were known about how the magnetic field can stimulate plant growth or even prevent it. In the beginning of 1980s Japanese called Fujio Shimazaki working in Shimazaki Seed Company, was the first who reported that stationary magnetic fields can improve the germination of seeds and speed up the growth of plants (Wojcik, 1995). Jones *et al.* (1986) found that the electromagnetic fields amplify the plant growth regulator induced Phenylalanine Ammonia-Lyrase during cell differentiation in the suspended cultured plant cell. Scientists have been confused between the effect of magnetic forces and the effect of gravity. For that they start their experiments to know the effect of magnetic forces away from gravity effect. From the important work in this subject is that carried by Nechitailo *et al.*(2001) carried their experiment in Magneto-gravistat on the orbital space stations ″ Salut″ and ″ Mir ″ to examine the spatial behavior of the flax (*Linum usitatissimum* L.) seedlings in a uniform magnetic field. They found that this field can display sensory organelles (statoliths) inside receptor cells and such displacement should cause a physiological reaction of the plant- tropistic curvature. 93% of the seedlings were oriented in the field consistently with curvature in response to displacement of statoliths along the field gradient by ponder motive magnetic forces, while control seedlings grew in the direction of the initial orientation of the seed. They suggest that gravity receptors of plants recognized magnetic forces on statoliths as gravity, and that gravity stimulus can be substituted for plants by a force of a different physical nature. Taia *et al.* (2005& 2007) found that the static magnetic forces greatly affect the rate of germination, growth and the photosynthetic pigments of the early stages of Ocimum basilicum L. (Lamiaceae).

Ellingsrud and Johnson (1993) among others noticed that the electromagnetic Radio-Frequency caused perturbations of plant leaflet rhythms, flowers as well as morphological and physiological characters of plants. Thus they concluded that the electromagnetic fields affect plant characters. The effect of magnetic forces on the taxonomic characters of *Ocimum basilicum* grown in Saudi Arabia exposed to different forces of static magnetic field originating from three directions (above ground, surface ground and underground as shown in Fig.3 has been carried by Taia *et al.* (2005) and Taia *et al*. (2005 & 2007) They found that the leaf morphology characters as well as water contents and photosynthetic pigments have been significantly affected, as well as the color and length of the plant and internodes. The ratio of shoot to root systems has been greatly varied under different exposures. The shape of root system and number of secondary roots were significantly changed. The length of the inflorescence and the state of the flowers showed great variations as well. These can indicated that magnetic forces, wherever their directions, affect the taxonomical characters of the plants and can leads to species variations.

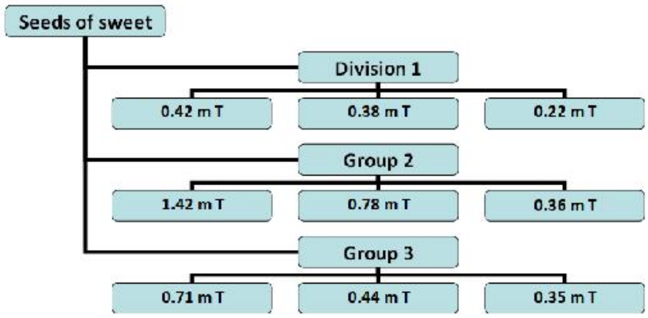

Fig. 3. Experimental set up of sweet basil seeds division 1 Group 1= magnet above soil surface; Group 2= magnet at soil surface; mT=milli tesla Group 3= magnet beneath soil surface (Taia and Kootbi, 2007)

Taia and Kootbi (2007) made investigation on the effect of magnetic force emerged from three directions with three forces in each thirty five taxonomical characters in *Ocimum basilicum.* They found great effect on the morphological characters between the three regimes as well as between the different forces (Table 2). They found that the exposure of the seeds of *Ocimum basilicum* before germination gave better appearance of the emerging seedlings after five exposure cycles each 15 min. separated by an hour. Plants germinated under the effect of magnetic exposure were completely different in their leaf characters than those in the pre-exposure ones. Even the Pollen grains greatly affected by magnetic forces, as most of the treated, as well as, the control have immature pollens after three months of cultivation. Mature pollen grains are found only at 1.42 ml. T., soil surface regime, and 0.71 and 0.35 ml. T. under soil surface regime only. In spite of that, pollens from mature plants have been studied in order to compare the effect of the magnetic treatments on both pollen shape and size. The pollen shape in the matured untreated plants is sub oblate with six colpi, the exine is tectate reticulate with hexagonal luminae and narrow muri. In the treated plants the type and number of aperture didn't show any difference, but pollen shape has been slightly changed and become spherical in the soil surface regime 1.42 ml. T. The luminae become irregular in 0.71 ml. T. under soil surface magnet or remain hexagonal in 0.35 ml. T. of the same regime or become longitudinally elongated in1.42 ml.T. soil surface regime. These investigations, beside many, indicated that the exposure to static magnetic forces changed the appearance of the plants, pollen maturity and characters, seed characters as well as their physiological activities. In the present days, the world electromagnetic equipments, mobile phones, microwaves and all the daily used electrical equipments have changed the static magnetic force in our environment. We can observe how much the features of all living organisms have been changed. This modified magnetic force can led to great confusion in the taxonomic decision.

Dehydration and its effect on pollen grains: From the most important tool in plant classification is the pollen grain morphology. The outer layer of the pollen grain, the exine, consider from the most resistant chemical compound, sporopollenin, wall. This wall considered to have fixed characters which are of use in taxonomical decisions since Wodehouse (1935). Unfortunately, under water loss and environmental changes, the pollen grains have been exposed to changes in their shapes and shrinkage in a phenomenom called harmomegathic effect. The harmomegathic effect of pollen refers to pollen shape under different status of turgescence (pollen in dry or in turgescent state), and only indirectly to the physiological status ((Pacini and Hesse, 2012). This criterion affects not only the shape of the pollen grains, but also the aperture shape and result in thinning in the external wall of the pollen grains forming pseudo-colpi, rugulate surface, tectate–columellate ultra structure, and a transverse grooves (Volkova *et al.*, 2013). Accordingly, the characteristic features of the pollen grains will change and cause misidentifications of the taxa.

Genetic diversity: Scheiner (1993) pointed to the interaction between the genome and environment in the process of forming morphologically different individuals. Pianka (1988) and Grime (1994) have pointed to the response of plants to environmental and climatic changes which may be under genetic control or may evolve under selection. In the last case, there is possibility of arising of new traits which allow species to adjust to the new environments as mentioned by Mazer and Gorchov (1996). Grimm *et al.* (2013) pointed to the importance of species richness and species evenness as key role to measure how the population can adapt to environmental changes. Pauls *et al* (2012-2020) announced that the increase in population bottleneck due to extreme weather events, genetic diversity in the population would drastically decrease. Accordingly the whole ecosystem will be affected and decrease the possibility of developing the ecosystems. More dramatically, the loss in genetic diversity will increase the possibility of extinction of the present species (Chapin *et al.* 2000). Since long time ago, scientists warning about the effect of environmental changes on species which under genetic control or even evolved from natural selection (Schlichting and Levin, 1984; Schlichting, 1986; Sultan, 1987; Pianka, 1988 and Grime, 1994). In this case, new traits were evolved which allow species to adjust to the new environments as indicated by Mazer and Gorchov (1996). Dunn and Sharitz (1991) and Mazer and Wolfe (1992) made practical experiments on individuals of *Murdannia keisak* growing in different populations and found differences in plant biomass, shoot length and even reproductive growth. These above mentioned observations, flash the light on how much the environmental disorders affect plant populations, richness, evenness, gene interactions and accordingly morphological and physiological characters. Heslop-Harrison (2017) studied how morphological adaptation in response to environmental changes is due to Genetics and genomics alteration. He postulated a scheme illustrating the relation between environmental changes; with implications for ecology and ecosystems; as well as development and evolution. As the result to morphological changes, new species arise and phylogeny progress (Fig.4)

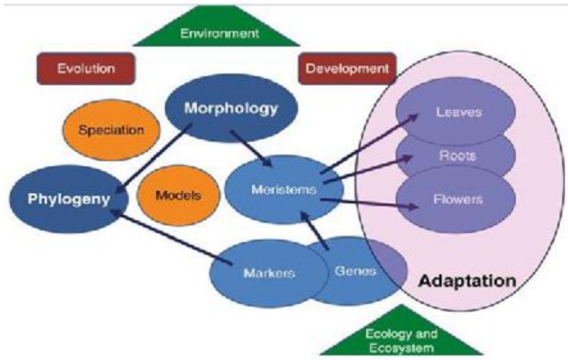

Fig. 4. Plant adaptation arises from their morphology, itself a product of evolution and development. In this figure, the aspects and interactions of research at different levels are shown, including understanding plant phylogeny and speciation, and for ecology and ecosystems (Helop-Harison, 2017)

Plant taxonomy under these circumstances: Plant taxonomy, which is the science of grouping plants according to similarities in graduated ranks, will start new era after this situation. Corona virus is greatly affects the environment, and as mentioned before, decrease air pollution, CO_2 and N concentrations in the air. These alterations not only affect plant populations, density, distribution and diversity but also affect plant morphology, physiology and anatomy. As we mentioned, plants develop dynamic phenotypes from their interaction with the environment. Accordingly, studies must be taken to understand these processes that change plant's lifetime in a permanently changing environment. The plant research community was thus confronted with the need to accurate measure diverse traits of large number of plants to know the limit of adaptation and phenological changes in response to environment. Pieruschka and Schurr (2019) sketch the technological advancement that laid the foundation for the development of phenotyping centers and evaluate the upcoming challenges for further advancement of plant phenotyping. Taia (2020) encouraged taxonomists to survey the vegetation and to modulate the thinking of the taxonomists in response to environmental changes. In the present situation, journeys to survey the vegetation became difficult, but we must look around to see the changes happened in the morphological features of the plants. As mentioned by Taia (2020) taxonomists must change their mind to correlate the changes happened in the morphological characters with the changes happened in the environment. In taxonomy, the neglect of the morphological characters considers an error which delayed the taxonomic decisions. Most of the taxonomic works rely on herbarium revisions of the specimens beside field journey, but under the situation of the virus those two jobs became under precaution. The work has to modulate and turned on to computer revisions of the specimens and constructing taxonomical keys with the consideration of the degree of the phenotypic plasticity within the taxon. Taxonomists must think how much the individuals can be affected with the environmental changes and this will cause either extinction of some species, self sterility or arising new species.

For that we can consider Cota-Sánchez (2020) approach to plant taxonomy as in the past and be back to traditional taxonomy, return to classic morphological investigations. Meanwhile taxonomists have to be very precise in examining the individuals and choosing the characters they will relay on it in their classifications.

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