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NANOTECHNOLOGY AND ITS IMPACT ON ORNAMENTAL PLANTS: A REVIEW

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ABSTRACT

Nanotechnology defines as directing, constructing and restricting materials and devices on the scale of atoms and molecules. The production of nano material results in the production of large quantities with nanoparticle in the range of 1 to 100 nanometer extents and preparation of these particles involved different chemical and physical methods. It covers a broad range of applications in various fields like nanomedicines, nanobiotechnology, green nanotechnology, industrial applications, energy applications and also nano art etc. As we know, Nanotechnology has gotten worldwide attention, so several developed countries taking part for its commercialization and contributes a major share of their economy. But developing countries remain in low progress because of little resources. Nanotechnology plays a vital role in agriculture sector through its applications in pesticides, fertilizers and also growth regulators. Ornamental plants are greatly affected by this technology having long shelf life, holding their ornamental quality for long time, inhibiting bacterial growth and also to obtain high yield.

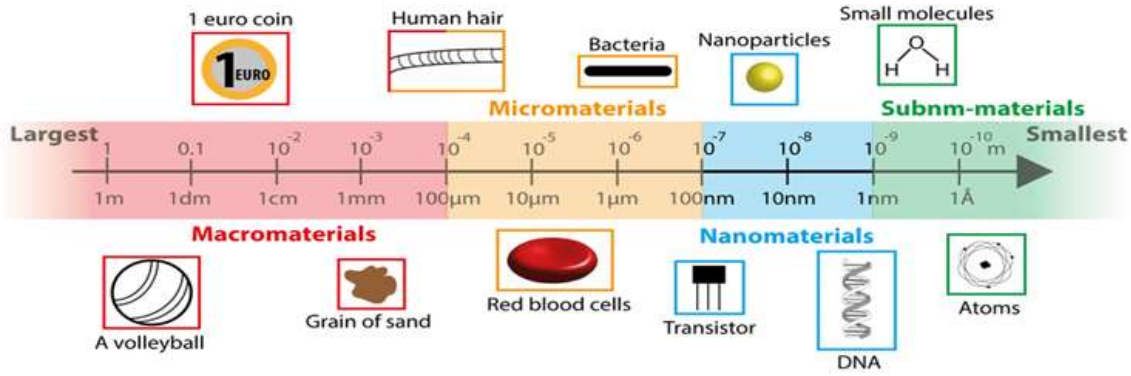
Keywords: nanotechnology, nanomaterial, advance collaboration, nanoagriculture, ornamental plants

INTRODUCTION

As nanotechnology is new approach but the presence of efficient expedients and structures of nanometer is not fresh. In the point of reality, arrangements of nanomaterial have occurred on earth as long as life itself [1]. The term 'nano' originates from the Greek word "nanos" that import dwarfness in the manipulation of material on an atomic, molecular or supra molecular scale. But the word "nanotechnology" generally includes materials made by humans only. Nanotechnology relay on the recognition of particles that have size less than 100 nano meters, that impart to construct structures, plans and schemes with novel features resultant from new design and engineering at particularly minor level [2]. The idea of nanotechnology was originally presented by Richard Zsigmondy, the 1925 Nobel Prize Laureate in chemistry. He developed the term nanometer clearly illustrating particle size and first time in the history measured the size of gold colloids by a microscope [3]. Since the visionary paper of Feynmann in 1959, precursor of the word nanotechnology by Japanese, Taniguchi in 1974, and the field remains dormant for many years. A revolution has occurred in this area during the last 10 years. In 1980, with the advent of computing and modulation scientist were able to understand the properties such as physical, chemical, mechanical, optical and magnetic at nano scale [4].

What are nanoparticles and nanomaterial?

Simply nanoparticle is ultrafine unit with dimensions measured in nanometers which are created by human activities as well as naturally, while nano material is composed of unbound particles and has at least one external dimension. In 2008 the International Organization for Standardization (ISO) expressed a nanoparticle a distinct binary dimensional nano-objects (i.e., nano discs as well as nano plates) and single dimensional nano-objects (i.e., nano filaments and nanotubes). The moral stuffs of nano constituents arise fairly from high surface-area-to-volume ratio as a result of large proportion of constituent grains that reside at the particle boundaries [5]. A great progress has been made in the production of nano material resulting in the production of large quantities with typical particle magnitudes in the 10 nanometer range. Numerous "modern" nano materials have been organized by physical gas-phase concentration or chemical synthesis systems [6].



Nano materials have a characteristics dimension in the range from 1-100nms. The presented length offers a frame of references for a reader [7].

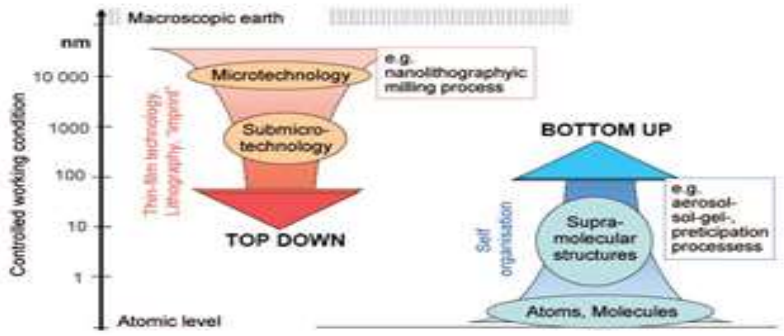
Applications of nanotechnology;

Nanotechnology is touching world- wide public attention due to its broad scope of claims that could intensely control both the scientific communal and the commercial market place [8]. The dental nano composite system shows high translucency and high polish retention similar to those of micro fills while maintaining physical properties [9]. In the case of cancer, nano devices are 100-1000 folds smaller than tumor cells so their presentation in cancer treatment will be an important addition to the currently available armory for cancer therapeutics and imaging [10]. Nanotechnology based material and products that are either on the market or ready to be adopt in the concentration industry are provide [11] on the other side a number of nano size fillers and their resultant induce a new concept of textile surface coating [12]. Nanotechnology may revolutionize the food industry as nano composites provide stronger, high barrier packing material, more potent anti -microbial agents and nano sensors which can detect trace contamination, gasses or microbes in packaged foods [13].

Preparation of nanoparticles

There are two main approaches for the preparation of nanoparticles, Top down and Bottom up but the selection of method hang on a number of aspects such as particles size ,their distribution and zone of request etc. [14]. In top down strategy, nano fibers are prepared via ultrasonic assisted way from crab bullets with an average diameter of 5nm consuming length less than 3µm as examined by atomic scope microscopy and transmission electron microscopy. These nano fibers are used as the precursor substantial for the research of nano particles and point of acetylation of these primed nano structures are establish to about 98% [15]. On the other hand , bottom up method is

spray based containing nano spray dehydrating, atomizer flow reactor method, spraying of low-electrical conducting solutions [16] are involved.



Advance collaboration in world regarding nanotechnology

As Nanotechnology holds a huge and countless display of strategies from different fields [17] and demonstrates a great assurance for providing revolutions that will change the way of technological improvements in a wide range of solicitations. Numerous networks for nano science exploration have been established, comprising the four networks supported by the National Agency for the Promotion of science and technology (ANPCYT) for molecular, supra molecular, nanostructure material, bio nanostructures and the scheme and stimulation of nano devices and models [18]. Throughout the period of 2002-2005, those networks elaborate 300 researches, 77 research and education institutes, 13 enterprises, broadcasting more than a thousand research articles and attaining more than 90 patents [19]. Advanced developed countries including US, Japan and member of united Europe are contributing billions of dollar annually in nano scale exploration to form the scientific foundations for nanotechnology commercialization [20].

Nanotechnology and agriculture

Agriculture supports the economy of developing countries and the development of the agriculture stands essential for the purge of poverty and hunger, to get rid of from this situation. In recent times (relative to the total span during which humankind practiced agriculture) the people involved in cultivating the field has fallen dramatically. Whereas, in 1700 about 60% of the working population of Great Britain were involved in agriculture, 200 years later this amount had fallen to 15% and 100 years after that was mere 1% [22]. Similar trends were found in other countries, although Britain is one of the more dramatic examples.

As agriculture counted with many critical problems in term of lack of new arable soil, decline of the current agriculture land, due to competing economic development actions, service requirement, scarceness and starvation, therefore application of nanotechnology in farming on the source of provided food, provender, stuff, fire and fuels [23]. If these problems are solved out, nanotechnologic interventions in farming has optimistic prospects for fruitful efficiency of nutrient used through bio nanotechnology, observation and resistor of pest and diseases, empathetic mechanism of host parasite interaction at the molecular level, advancement in new generation pesticides and their shippers, conservation and wrapping of food and food flavors, strength of natural fibers, subtraction of contamination from soil and water, refining the shelf life of vegetables and flowers, clay based nano possessions in water management accuracy, recovery of salt-affected soils and steadiness of erosion –prone surfaces [24].

Table 1: Shows international share of different countries towards nanotechnology collaboration during last 20 years and also provide ranking numbers [21].

Country (regions)	1991–1997 Rank (share)	1998–2003 Rank (share)	2004–2010 Rank (share)
USA	1 (20.7 %)	1 (32.4 %)	1 (36.0 %)
Germany	2 (12.2 %)	2 (11.8 %)	2 (7.4 %)
Japan	8 (2.4 %)	5 (4.9 %)	3 (5.7 %)
Canada	8 (2.4 %)	4 (6.1 %)	4 (4.6 %)
UK	5 (9.8 %)	3 (7.0 %)	10 (2.8 %)
France	4 (11.0 %)	6 (4.8 %)	8 (3.8 %)
Switzerland	2 (12.2 %)	7 (4.3 %)	9 (3.5 %)
China	11 (1.2 %)	10 (2.1 %)	6 (4.5 %)
Taiwan	11 (1.2 %)	15 (1.3 %)	4 (4.6 %)
South Korea	15 (0.0 %)	15 (1.3 %)	7 (4.3 %)
Netherlands	11 (1.2 %)	11 (2.0 %)	13 (1.9 %)
Belgium	15 (0.0 %)	11 (2.0 %)	12 (2.1 %)
Sweden	6 (4.9 %)	9 (2.3 %)	14 (1.4 %)
Israel	11 (1.2 %)	13 (1.9 %)	19 (1.1 %)
India	15 (0.0 %)	18 (1.0 %)	11 (2.2 %)
Russia	15 (0.0 %)	8 (2.4 %)	19 (1.1 %)
Singapore	15 (0.0 %)	17 (1.2 %)	16 (1.3 %)
Australia	8 (2.4 %)	19 (0.7 %)	14 (1.4 %)
Italy	15 (0.0 %)	14 (1.4 %)	18 (1.2 %)
Spain	7 (3.7 %)	20 (0.4 %)	16 (1.3 %)

Table 2: Elaborate the constrains of today life in agriculture, their solutions and also used nano material

Constrains	Nano material	prospects	Reference
Soil erosion	Iron NPs	increase aggregation	[25]
Food packaging	AgNPs	inhibit microbes	[26]
Water contamination	TiO^2	clean water	[27]
Food processing	3-fattyacids	improve texture	[28]
Biosensors	CoNPs	High detection	[29]
Oxide stress in plant	TiO^2	protection against toxicity	[30]
protein deficiency	ZnONPs	increase vegetarian protein	[31]

Economic status of ornamental plants

The term ornamental plant is generally used for garden plants; in other language these plants are cultivated for display purpose, rather than functional ones. They have a great diversity in their growth habit from cut foliage, flowers, bedding, potted, outdoor, indoor, and bulbous to annual, biennial or perennial. With the advancement in trends, the rapid rise is seen in ornamental plants which covered the 42% of total cash received from horticulture farms and 6% of all agriculture farms in Canada [32]. The cut flowers segment accounted for highest revenue share contribution as compared to other type segment and is expected to register a CAGR (compound annual growth rate) of over 5% between 2017-2026, owing to its beauty and sweet fragrance (GFM, 2018) while countries with the largest share in cut flower production are Germany (11%), Italy (18%) and the Netherlands (35%). The successful application of various nano platforms in medicine has generated some interest in agro-nanotechnology for increase the quantity and quality of agricultural and horticultural products. Where biotechnology advances in protection and nutrition strategies for plants have attempted to provide some solutions for the problem caused by application of chemical fertilizers [33]. similarly agro-nanotechnology holds the promise of controlled release of agrochemicals and site targeted delivery to improve efficient nutrient utilization and enhanced plant growth [34]. Research regarding plant-nanoparticle interaction started when [11] first reported uptake, accumulation and transformation of ENPs in the plant body. Others application are also considered based on success in the use of this technology to increase agriculture production and decrease postharvest waste.

Here we take a look on some application of nano materials in flowers and its impacts.

Nano-sponges (ß-cyclodextrin) have a capability to enhance efficacy of the ethylene inhibitor1-MCP (1-Methylcyclopropene) in several flower species, senescence symptoms were decreased or delayed. Anemone and Poppy has a longer esthetic flower quality and vase life, and a reduced petal abscission. In Ranunculus, ß-CD-NS complex improved longevity. In Sunflower, it maintained longer chlorophyll leaf content and cut flower ornamental value. Poeny opened more slowly and Rose maintained its ornamental quality longer than 1-MCP treated flowers. In Carnation (Dianthus chryophyllus) 1-MCP included in nano sponges also allowed batter control of Botrytis cinerea damage and also extend the postharvest longevity when

applied with different concentration in tap water [35].

Nano-fertilizers are actually encapsulation of plant nutrient in unique way either by packing nutrient inside the nano porous material [36] and have large cavities inside their structures which can filled with nitrogen or phosphorous along with trace elements and releasing them slowly in the soil system [37]. They are enhanced the N, P, K and Fe concentration in leaves when applied at 10mg/ 1, increase the photosynthetic pigment chlorophyll content in leaves of Buxus plant [34].

Nano-encapsulation refers as use of pesticides in safe and sound ways. Nano encapsulated pesticide formulation is able to reduce the dosage of pesticides and human exposure to them, which is environmental friendly for crop protection [38] The highest yield of Marigold can be obtained from 1g/liter at stem initialized [39].

Nano-particles Nanometer –sized silver (Ag+) particles are used in various applications as an anti-microbial like NS plus treatment inhibited bacteria growth in Gerbera flower [40]. similarly ZnONPs inhibit the bacterial growth in Rose and other cut flowers [41].

FUTURE THURST

As the world population is growing rapidly so the demands are also increased not only in term of food but also feed, fiber and fuel. Regardless of the promising development of nanotechnology in various field, its agriculture applications have not been translated to meet global needs primarily due to shallow awareness and biosafety concerns. Simultaneously uncertainty and negative perception via nanotechnological interventions in agriculture sector must be taken seriously. However, the demand of the cut flowers and live plants is increasing day by day with the increasing standard of living, aesthetic sense and awareness in the people. Growers as well as the government need to develop a proper strategy for floriculture products at national and international levels in per with other export agricultural crops in the country.

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