Study the effects of climate change on application of gene silencing in weed science

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Abstract

Abiotic stress conditions cause extensive losses to agricultural production worldwide. The acclimatization of plants to climate change was make proportional response and causes well-set feedback in many category of genes. Global warming is generating rapid changes in temperature. Plant acclimation to climate change needs an appropriate response to the exact environmental condition. GM crops enable a promising way to decrease yield losses, ameliorate growth, and provide a confident food supply for a growing world population. One of the strategies for creating transgenic plants using gene silencing by small RNAs. Some scientists stated that the Orobanche M6PR gene is a potential target for attempts to control this parasite. Transgenic tomato plants were produced bearing a specific 277-bp segment from M6PR-mRNA of Orobanche aegyptiaca. M6PR-siRNA was found in three separate and independent tomato lines (transgenic) in the R1 generation, but was not detected in Orobanche aegyptiaca. On the other hand, global temperature in different years and regions is changing, whether such genetic changes recommended for weed management and sustainable use. Because, heat stress has been reported to change small RNAs (miRNA) expression in some plant species, so the researchers reported that in Brassica rapa seedlings which was exposed to high temperature (46 °C for 1 h), miR399b, miR827, miR5716, and miR1885b.3 levels were decreased. So it seems that gene silencing process which causes transgenic plants should be tested in different and unusual temperature ranges and maybe it seems like that it does not work well in climate change especially in global warming.

Key words: Global warming, GM crops, Small RNAs.

Climate change

In the event that the sun’s imperativeness amassed industriously on Earth, the planet would get more sweltering and sultrier. For every businesslike explanation behind existing, Earth’s air depends on upon essentialness that gets in contact from the sun, and what happens to that imperativeness once it accomplishes our condition. Since Earth is so impressively cooler (in regard to the sun), less imperativeness is lost, and the essentialness that pulls back has, generally
speaking, any more (and likewise less competent) wavelengths. All the more a given greenhouse gas will mean greater essentialness digestion at the specific wavelengths devoured by that gas. The leaving essentialness falls into the infrared piece of the electromagnetic range and is thusly defenseless against ingestion by nursery gasses. As distinct sorts of greenhouse gasses enter the air, they increment vitality retention at a more extensive scope of wavelengths. Human activities are at the same time decimating ozone in the stratosphere and empowering its generation in the troposphere. As this ozone is crushed through joint efforts with CFCs and diverse chemicals, a more noteworthy measure of the risky radiation accomplishes the world's surface, hurting nucleic acids and the photosynthetic mechanical get together. A hazardous environmental deviation (a worldwide temperature alteration) intervened by nursery gasses and the ascending in air haze concentrates causes an ascending in the measure of water vapor, adjusted precipitation rates and rehash, drying of the land surface, and tropical tornados, affecting to an extraordinary degree both the biosphere and hydrological cycle (6, 8, 16, 19). Many produced halocarbons, including the CFCs that decimate ozone, are themselves effective nursery gasses, regardless of the way that they exist just in little concentrations in the atmosphere.

**Gene silencing and climate change**

Gene silencing can be either posttranscriptional gene silencing (PTGS) or transcriptional gene silencing (TGS). Post transcriptional gene silencing (PTGS) is all the more famously utilized for gene function analyses. RNAi in plants can be accomplished by communicating hairpin RNA (hpRNA) that crease back to make a double-stranded RNA (dsRNA). These hpRNAs are strong inducers of PTGS and give ascent to 21–23 nucleotides small interfering RNAs (siRNAs) derived from the dsRNA by RNase III-like enzymes called Dicers. Then the siRNAs collect into endoribonuclease-containing complexes known as RNA-brought about silencing complicated (RISC). The siRNA strands finally guide the RISCs to complementary mRNA molecules, where they cleave and spoil the cognate mRNA hence causing PTGS. miRNA-mediated PTGS is a natural targeted gene silencing phenomenon inherent in plant life for gene regulation at some point of plant development and stress responses. Some miRNAs cause the manufacturing of secondary siRNAs from their objects. miRNA-induced gene silencing (MIGS) is an emerging subject to silence more than one gene that might not have overall sequence similarity (15). miRNA qualities are transcribed by RNA polymerase II, producing long essential miRNA transcripts. These transcripts can embrace clip like structures due to defective self-complementarity and such structures fill in as substrates for the chemical Dicer-like 1 (DCL1), discharging miRNA duplexes around 21 nucleotides in length. In spite of the fact that DCL1 is the real protein involved in miRNA biogenesis, a few other twofold stranded RNA-restricting protein(s) and DCL1-collaborating proteins, for example, HYL1 (hyponastic leaves 1), SE (serrate), DDL (dwaddle-like), CBP80 (top restricting protein 80), CBP20 (top restricting protein 20), STA1 (settled 1), what's more, CPL1/FRY2 (C-terminal area phosphatase-like 1/FIERY 2) are additionally basic in discharging the miRNA and (miRNA is the corresponding strand of the develop miRNA) duplex from the fastener like structure [20,3136]. The prepared develop miRNAs are stacked into RNA-initiated hushing complex (RISC), though miRNA species are normally corrupted quickly. Guided by base blending between miRNAs and reciprocal target mRNAs, the RISC causes to a great extent transcript cleavage or translational restraint, in this manner adding to post-transcriptional quality control in plants (Figure 1) (4,20).
On the other hand, GM crops enable a promising way to decrease yield losses, ameliorate growth, and provide a confident food supply for a growing world population (11). One of the strategies for creating transgenic plants using gene silencing by small RNAs. Species of Orobancheaceae parasitize the roots of close by host plants to rob them of water and different nutrients. Parasitism may be debilitating to the host plant are parasitic weeds. Some researchers revealed that interfering hairpin constructs transformed into host flowers can silence expression of the focused genes within the parasite. Transgenic roots of the hemi-parasitic plant Triphysaria versicolor expressing the GUS reporter gene were allowed to parasitize transgenic lettuce roots expressing a hairpin RNA containing a fragment of the GUS gene (hpGUS). When stained for GUS activity, Triphysaria roots attached to non-transgenic lettuce showed full GUS activity, however those parasitizing transgenic hpGUS lettuce lacked hobby in root tissues distal to the haustorium. Transcript quantification indicated a reduction within the regular-state level of GUS mRNA in Triphysaria when they have been attached to hpGUS lettuce. Those consequences exhibit that the GUS silencing sign generated by using the host roots became translocated throughout the haustorium interface and become functional in the parasite. Motion throughout the haustorium was bi-directional, as confirmed in double-junction experiments wherein non-transgenic Triphysaria concomitantly parasitized hosts, one transgenic for hpGUS and the other transgenic for a purposeful GUS gene. Commentary of GUS silencing within the second host verified that the silencing trigger might be moved from one host to any other using the parasite
as a physiological bridge. Silencing of parasite genes by way of generating siRNAs inside the host affords a new method for controlling parasitic weeds (18). Also several scientists used gene silencing to develop new transgenic resistance in host plants, to help manage weedy root parasites in agricultural crops. In fact, mannose 6-phosphate reductase (M6PR) is a key enzyme in the biosynthesis of mannitol, and so the accumulation of mannitol may be very important for the development of Orobanche aegyptiaca (parasitic weed), as it accumulates in a large amount in this weed during the development. Therefore, the scientists stated that the Orobanche M6PR gene is a potential target for attempts to control this parasite. Transgenic plants of tomato were produced bearing a specific 277-bp segment from M6PR-mRNA of Orobanche aegyptiaca. M6PR-siRNA was found in three separate and independent tomato lines (transgenic) in the R1 generation, but was not detected in Orobanche aegyptiaca. Quantitative analysis (quantitative RT-PCR) showed that the value of endogenous M6PR mRNA in some parts of O. aegyptiaca grown on transgenic tomato plants (host) was reduced by 60%–80%. At the same time along with M6PR mRNA suppression, there was a significant decrease in mannitol level and a significant increase in the percent of dead tubercles of O. aegyptiaca on the host (transgenic tomato plants). The found of mir390, which is involved with cytoplasmic dsRNA processing, was the first symptom of the existence of gene-silencing mechanisms in the parasitic weed. Gene silencing mechanisms are probably involved with the production of decreased levels of M6PR mRNA in the parasites grown on the transformed tomato lines (1). Climate change is an important issue in this process. Because the productivity, sustainability and performance of small RNAs is affected by environmental conditions. While global temperature in different years and regions is changing, whether such genetic changes recommended for weed management and sustainable use. Because, heat stress has been reported to change small RNAs (miRNA) expression in some plant species. Upon exposure to stress, plants use more than one gene regulatory mechanisms to repair mobile homeostasis in addition to to decrease the adverse effects of stress. Transcriptional regulation all through stress is the essential mode of gene regulation (3). The importance of post-transcriptional gene regulation at some point of strain changed into realized whilst correlations between mRNA abundance and respective protein levels had been now not obtrusive (10). Altered miRNAs sooner or later impinge upon their targets and modulate their expression. Heat stress has been pronounced to modify miRNA expression in numerous plant species, which include Triticum aestivum (20). miRNAs responsive to heat stress are in large part either upregulated, as determined in T. aestivum and B. rapa, or downregulated, as suggested in P. tomentosa. In T. aestivum, miR156, miR159, miR160, miR166, miR169, miR827, miR2005, and miR168 have been upregulated, while miR172 changed into downregulated underneath heat stress (40 °C for 2 h) (20). In B. rapa seedlings uncovered to excessive temperature (forty six °C for 1 h), miR156, miR5714, miR5718, and miR5726 ranges had been upregulated, while miR399b, miR827, miR5716, and miR1885b.3 ranges were decreased (21). In evaluation to the found upregulation of miRNAs in T. aestivum and B. rapa, the woody plant P. tomentosa showed in most cases downregulation of miRNAs under heat stress (37 °C for 8 h) (4).

Drought-responsive miRNAs were identified in some plant species, along with A. thaliana, Oryza sativa, Triticum dicoccoides, Medicago truncatula, Phaseolous vulgaris, and P. trichocarpa (14, 17, 22, 23). Drought upregulated the expression of miR393, miR397, miR402, miR167, miR168, miR171, and miR396, whereas it downregulated the expression of miR398 in Arabidopsis seedlings (13, 17). Drought induced upregulation of miR396 in A. thaliana, while it changed into downregulated in T. dicoccoides and O. sativa (13, 23). MiR169-mediated
induction of its target NF-YA5 transcription thing is important for expression of wide variety of drought stress-responsive genes. Transgenic plant life overexpressing NF-YA5 confirmed reduced leaf water loss and had been extra resistant to drought (12). A number of the GHGs, consisting of CO and NOx, react with unstable organics, which go through photochemical oxidation to produce tropospheric ozone (5). Some miRNAs like miR390, miR319, miR159, and miR156 confirmed upregulation within 1 h of ozone stress, and their cognate mRNA objectives have been downregulated swiftly (7). Nevertheless, under natural environmental conditions all the various factors causing climate change act in combination (6).

On the other hand, some scientists demonstrated that temperature and UV-B stress cause quick and heritable changes in the epigenetic control of a silent reporter gene in Arabidopsis. This stress-mediated release of gene silencing correlated with articulated changes in histone inhabitance and in histone H3 acetylation however did not include conformities in DNA methylation. They observed transmission of stress impacts on reporter gene silencing to non-stressed progeny, but this effect was restricted to areas consisting of a small number of cells and limited to a few non-stressed progeny generations. The transient nature of this phenomenon highlights the ability of plants to restrict push instigated unwinding of epigenetic control mechanisms, which likely contributes to safeguarding genome integrity.

**What should happen in the future?**

First, what you should seriously consider, inhibition of drastic changes and prevent the severity of climate change with a series of logical processes, scientific and efficient. Should be considered until improved weather conditions preventive or control actions in relation to some biological processes. In fact, due to the biological nature of these processes, they cannot act independently of environmental conditions. Therefore, due to the more diverse and faster climate change, it seems that should be examined not only warmer weather effects in different regions but also the effect of changes in weather conditions around the globe happen and the combined effect of these changes on the gene silencing process. We believe that given the prevailing conditions on the Earth's climate until the logical containment of climate change is better that created transgenic products to better manage weeds are recommended for the area, however, this claim needs extensive research and long-term.

**References**


