Research & Reviews: Journal of Botanical Sciences

e-ISSN:2320-0189
p-ISSN:2347-2308

Extensive Genetic Diversity a Profitable Tool to Improve Eggplant against Drought Stress

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Mini Review

Received: 07/01/2019
Accepted: 28/01/2019
Published: 08/02/2019

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Keywords: Eggplant, Aubergine, Abiotic stress and genetic resource

ABSTRACT

Solanaceae is a source of several domesticated species with various morphological traits. The various diversities could be observed among Eggplants population. Eggplant is sensitive to water shortage stress and needs adequate water during its growing season, but it is more tolerant to drought and heat stress than the other vegetables and *Solanum* genus. Induction of tolerance to abiotic stresses is one of major breeding programs in eggplants. Therefore, identification an existing genetic resources is the main stage to cope with abiotic stresses. Investigation among these categorizations could be beneficial to pick up proper class with morphological traits that are suitable to enhance drought tolerance. In this study several drought tolerant genotypes and also beneficial traits have been presented that could be utilized in eggplant breeding programs to cope with drought stress condition.

INTRODUCTION

Solanaceae is a great family composed of 2300 species. This family is a source of several domesticated species with various morphological traits. Eggplant is a diploid autogamous species with 12 chromosome belonged to this family [1]. There are three crop species belonged to eggplant including: brinjal eggplant or aubergine (*S. melongena*), Gboma eggplant (*S. macrocarpon*) and scarlet eggplant or jaxatu (*S. aethiopicum*). Aubergine is a popular eggplant with a wide distribution all over the word. India and Indochina have been introduced as diversity center of aubergine whiles middleeast and Mediterranean environs have been introduced as secondary distribution center [2]. Primary *S. melongena* are height with long and prickly leaves, clustered flowering, small, green and bitter fruit, thick fruit skin with firm fruit meat [1]. The various diversities could be observed among aubergines population. White to dark purple and often black fruit color, 4-45 centimeters in their fruit length, 2-35 centimeters in their thickness, 15-1500 gr in their fruit weight, various fruit shape, single to five fruit in a cluster [3]. Eggplant is sensitive to water shortage stress and needs adequate water during its growing season [4], but it is more tolerant to drought and heat stress than the other vegetables and *Solanum* genus [5,6]. Normally in warm and dry areas, drought may last for a long period of time with different intensity for several consecutive series. Considering these conditions, eggplant could tolerate abiotic stress condition [7].

LITERATURE REVIEW

Induction of tolerance to abiotic stresses is one of major breeding programs in eggplants. Therefore, identification an existing genetic resources is the main stage to cope with abiotic stresses. Eggplant showed high morphological variation within and between species [8]. *S. melongena* species are classified by [9-11]. According their morphological characteristics. Investigation among these categorizations could be beneficial to pick up proper class with morphological traits that are suitable to enhance drought tolerance.

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Drought tolerant eggplant resources

There are several studies that introduced tolerant eggplant genotypes, Florida Market (12), Supreme (3), Violette Round (3) and K (13) have been introduced as drought tolerant cultivars. Additionally, R34, PH 4 showed proper yield under summer heat condition. Some wild relative's eggplants could grow in desert and dry areas. *S. elaeagnifolium* introduced as the most drought tolerant species among all investigated wild relative eggplants. S. macrocarpon species has been also reported as one of important drought tolerant resources in eggplants [14]. Furthermore, *S. linnaeanum* and *S. torvum* [15] have been introduced as salt tolerant species. It is important to note that, although there are several abiotic tolerant genetic resources in wild relatives of eggplant but not necessarily all wild relatives are more tolerant than *S. melongena*. Therefore, there are rich genetic resources that could be utilized in breeding programs of eggplant.

Genetic resources suitable for blustery areas

During last decades an increase in drought severity especially in blustery areas play a critical role in creating dusty storms like "wind of 120 days" in eastern Iran and western Afghanistan. Growing season of aubergin occur within 120 days simultaneously. Thus, it is important to consider aubergins cultivated in these areas must tolerate dust storms in addition to drought and heat stress. The most important feature should be vigorous and firmer bushes that are less affected by severe winds. Dark purple eggplants (western) are less vigorous vice versa oriental eggplants. Oriental eggplants like Chinese that are vigorous and Japanese that are firmer and heavier are beneficial resources in this context. Plant height is the other characteristic that should be considered in dust stormy areas. Dwarf eggplants are less affected in these conditions. Furthermore, a hairy leaf absorbs more dusts in their surface than glabrous ones. On the other hand hairiness enhance drought tolerance through reduction of transpiration [16] . Thus hairiness is a challenging trait in dust stormy areas.

Morphological variation of eggplants under drought stress

There is a large morphological variation within and between of eggplant landraces [17]. This might amplify the selection potency of breeder against drought through selection of traits linked with drought tolerance. These traits could be biomass weight, plant height, maturity time, flowering time, fruit shape, flower color, fruit color, bush type, root forming, leaf length, leaf area, leaf numbers, leaf hairiness, leaf wax, branch numbers, stem diameters, shoot fresh weight, shoot dry weight, root fresh weight, root dry weight and some other traits. It has been reported that eggplant biomass weight and yield have been decreased under drought stress condition [13,17]. Additionally, leaf area, leaf numbers, branch numbers, stem diameters, root and shoot dry weight have been also declined by increasing drought stress [18]. Hairiness and waxy leaf could obstacle water wasting in vegetable crops [16]. Therefore monitoring these alterations could be beneficial to understand their relation to drought tolerance.

Physiological variation of eggplants under drought stress

It has been observed significantly reduction in transpiration rate, stomatal conductance and photosynthesis rate for eggplant under water stress condition. Water balance protection in the eggplant is a characteristic in eggplant that distinct this crop from other solanaceae family and vegetables [19]. This could be happen through keeping up RWC when moderate reduction of leaf water potential occurs, effective stomatal control in transpiration, appropriate osmotic adjustment, maintaining photosynthetic condition and the quick recovery after a period of water stress. Gradually closing stomata behavior is an important factor that enhanced drought tolerance in eggplant rather than threshold closing behavior in other vegetables. More stomata with smaller size under drought conditions has been also observed in eggplant leafs. Carotenoid concentration and some other photosynthetic pigments have been changed under drought stress. Consistence expression in leutein, reduction in carotenoid, chlorophyll, neoxanthin and vaiolaxantine, increment in zeaxanthin are some of these changes [20].

Additionally, proline plays an important role as osmoprotectant under drought stress [21] and its expression in eggplant is properly regulated. An increment in proline content under water deficiency with less and higher concentrations under moderate and severe water deficiency and also with the ability to return to previous level after water availability condition shows its high level regulation in eggplant that could increase eggplant adaptability to drought stress.

Genetic resources of early type's eggplants

Earlymot and Lakluster are among the 11 groups that are classified by Martin and Rhodes. These two groups both are early flowering, a very essential feature under drought stress that could help eggplant to escape from drought stress. Furthermore, according to the Sekara classification Oriental eggplants are early type. Therefore, utilizing these two groups in eggplant breeding program for drought tolerance induction could be beneficial.

Root features enhance drought tolerance in eggplant

It has been reported that characteristics of eggplant roots in water absorbance enhanced its tolerance to dry and hot climates [22]. Eggplant relatives introduced as a source for developing new rootstocks [23]. Eggplant root features made researchers to use eggplant as rootstock for tomato [22,24]. This enhanced feature may not be due to root forming and its water absorption capacity alone. Phytohormones like abscisic acid and ethylene produced by eggplant roots should also be considered in this context. It has been observed that tomato has been grafted onto eggplants exhibited lower proline and higher ascorbate levels compared with self-grafted tomato.

e-ISSN:2320-0189
p-ISSN:2347-2308

Fruit and flower color and their correlation with drought tolerance in eggplant

It has been reported that there is a correlation between production of anthocyanin in the shoot and root tissues of plant and drought tolerance induction [25,26]. The increased anthocyanin under drought condition has been observed in pepper. Anthocyanin induction leads to ROS reduction that could increase drought tolerance [27,28]. Therefore presence of anthocyanin in the different tissues of eggplant could cause increased tolerance under drought stress. It has been reported that there is a linkage between petal color and anthocyanin production in the different tissues of eggplant [14]. Thus this feature could be utilized as practical marker in selection of drought tolerant eggplants via selection of genotypes with non-white flowers.

CONCLUSION

Our investigation indicated there are extensive genetic variation in eggplants that some of them could pass through droughted condition. Furthermore, favorable genetic diversity for each trait helps eggplant breeders in selection of desirable traits that could enhance drought tolerance.

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