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Assessment Results and Reflections of Some Eggplant Breeding Projects Performed in Turkey

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ABSTRACT

Eggplant is a widely grown species among the Solanaceous crops in both greenhouses and the open field, consumed throughout all the year, it is very popular in Turkey. Eggplant breeding programs were carried out for improving open pollinated varieties launched for the public sector in the earlier 1960's. Many important open pollinated varieties which still maintains its importance today by the growers were developed. Hybrid eggplant breeding studies were first conducted at the Bati Akdeniz Agricultural Research Institute (BATEM) with the breeding project given support by the Ministry of Food, Agriculture and Livestock. Breeding studies focused on yield, fruit quality, and the development of long F_1 hybrid varieties suitable for growing protected cultivation, parthenocarpy, and biotic (Fusarium and Verticillium) stress resistance/tolerance. Resistance sources of Fusarium ox. sp. melongenae and its inheritance against had been investigated and a genetic linkage map has been constructed. Several projects, supported by both public and private sectors, have been carried out for twenty years. As an outline of the projects, four F_1 hybrids were developed and about 300 disease resistant inbred lines were transferred to special seed companies supporting the project financially. Additionally, a study was performed on morphologic and molecular characterization, and phylogenetic relationship of local genotypes. Also, considerable scientific publications were produced from these studies and shared by both scientists and breeders.

Keywords: Breeding, Fine mapping, Fusarium, Verticillium, Inheritance

Introduction

Eggplant is one of the most important and widely cultivated crop among the fruit bearing vegetables in Turkey. It was brought to the Turkey by traders from the Silk Road at the beginning of the 6th Century. It has a special place in the diet, and in the rich menus of traditional Turkish cuisine. It had only been cultivated in open field conditions until the middle of the 1970's. Although the first eggplant cultivation in greenhouses had begun in the 1940's, its commercial production started at the end of the 1970s with the purpose enlarge the diversity of vegetable consumption. The first experiment on growth techniques of eggplant under greenhouse conditions was performed at the Bati Akdeniz Agricultural Research Institute in 1978. After the positive results were transferred to the growers, eggplant greenhouse production had become increasingly common (Ekiz and Boyaci, 2001). At the present time, 30% of the total production is obtained from greenhouse cultivation, while 70% of it is obtained from open field cultivation (TSI, 2016). Turkey ranked the fourth amongst the top 5 eggplant producers worldwide in the last ten years with 850 thousand tons of eggplants produced on average (FAO, 2016). Almost half of the total country production is obtained from Mediterranean region in Turkey (TSI, 2016). The varieties for protected cultivation are mostly F_1 hybrids, and a large part of them are imported from abroad. The number of hybrid varieties used in the open field are increasing year by year (Boyaci et al., 2015). In Turkey, the domestic production of inbred cultivar seeds was 6,615 kg and that of hybrid seed 140 kg, the quantity of imported seeds were 3 kg for inbred cultivars and 256 kg for hybrid seeds in 2003 (Ozalp, 2005). The total amount of eggplant seed production, including both inbred and hybrid cultivars, reached 7932 kg in 2013. Though Turkey's eggplant seed import increased to 452 kg, the amount exported was 186 kg (Ozalp et al., 2014).

Vegetable breeding programs were started on inbred varieties being introduced to the public sector in 1960s in Turkey. The varieties long shaped Kemer 27 and oval shaped Topan 374 were developed by the public institution and registered in 1964. These varieties have still important cultivation areas and keeping their importance till now for open field cultivation. However these cultivars are not suitable for protected cultivation. The Bati Akdeniz Agricultural Research Institute breeding program has focused on the hybrid variety especially for protected cultivation, as well as for disease resistance.

In this paper, eggplant breeding studies carried out at BATEM for 20 years are summarized.

Bati Akdeniz Agricultural Research Institute (BATEM) in ruling with the General Directorate of Agricultural Research and Politics under the Turkish Ministry of Food, Agriculture and Livestock was

founded in 1933. The hybrid eggplant breeding program at BATEM appointed by the government in 1995 has been launched to solve problems encountered by the Turkish growers. A wide range of breeding activities have been performed for the selection of resistant plants to abiotic and biotic stresses. The breeding program has been aimed at developing new breeding lines and varieties. Conventional breeding methodologies, as well as molecular tools for the characterization, selection, enhancement and utilizations of genetic resources have been used.

The breeding activities, strategies, purposes, methods, results and their impacts in the last 20 years at BATEM are presented with project headline.

"Breeding of F1 Hybrid Eggplant Variety Suitable For Protected Cultivation"

Turkish growers had to use imported F_1 eggplant seed for greenhouse cultivation until they had their own improved local F_1 hybrids. This eggplant breeding project was appointed by the General Directorate of Agricultural Research and Policies to reduce dependency to external sources, and was carried out from 1996 to 2004. Moreover, the main problems faced in greenhouse cultivation during the winter season, such as low fruit quality, low yield due to unfavorable environmental conditions like low temperature, insufficient light intensity and high humidity, were expected to be solved with this project.

This project was performed in order to develop domestic hybrid variety so that they had a high fruit productivity, early yield, and were highly adaptable for different environmental conditions, thus becoming suitable for Turkish market demands. The study was started with the selfing of 134 materials that had variable genetic structures which were provided from different sources to generate segregating populations. These lines were selfed and selected in each generation according to the pedigree method until it became a pure line. 84 eggplant lines were chosen to measure general combining ability (GCA) and to test for yield and other quantitative traits. The pure lines that had high general combining abilities were subjected to the specific combining ability (SCA) test. After the experiments conducted in different ecological conditions, the F_1 hybrids numbered 76 and 78 appeared to be candidates for commercial variety. Both hybrids, well adapted to different conditions, had long shaped and dark fruit thus having good agricultural characteristics. These varieties were registered and named as Karadaylak and Cakildak respectively. They were the first eggplant Turkish hybrid varieties developed (Ozcelik et al., 2002).

"Research on GA_3 Levels Involvement in the Tendency to Parthenocarpy"

Eggplant cultivation under greenhouse conditions is generally concentrated on a single growing period especially in the Mediterranean region of Turkey. The plants are exposed to low temperatures during its growth and development stage throughout the winter season. The growers usually do not use heating systems to provide optimum conditions for growing due to high heat cost, while take simple preventions to chilling (Abak and Guler, 1994). Although eggplants are warm climate crops, optimum conditions could not always be provided due to the reasons mentioned above. Thus, the inability of pollen germination and fertilization caused 70 % of flower buds to wither, and so both fruit productivity and the amount of marketable fruit decreased. The most suitable solution for overcoming these problems was to develop new varieties which set fruit under low light intensity and temperature.

This study was conducted to determine generative and vegetative growth performances between parthenocarpic and non parthenocarpic eggplant genotypes in the winter season, so that morphological markers could be found in order to be used in eggplant breeding and to investigate GA_3 levels. The experiments were carried out in greenhouses and laboratories of Bati Akdeniz Agricultural Research Institute between 2001 and 2006. The materials used in this study were grown in an unheated greenhouse in a single growth period. The observations were made from November to March. Plant height, stem diameter, leaf number, yield, pollen amount, pollen viability, pollen germination and parthenocarpic fruiting of genotypes were determined. GA_3 levels were investigated in the samples collected from five different stages, ranging from the small bud to the small fruit. The responses of the genotypes were found significantly different for vegetative growth, pollen viability and fertility under low temperature conditions. The results showed that there was no relationship on vegetative and generative parameters and GA_3 levels between parthenocarpic and non parthenocarpic eggplant

genotypes (Boyaci et al., 2009a,b; Boyaci et al., 2011a). It was understood in this study that the parthenocarpy feature in eggplant is strongly influenced by environmental effects. So it was not possible to make progress on the development of the parthenocarpic eggplant variety with conventional breeding methods.

"Resistance Resources and its Inheritance against Fusarium Wilt in Eggplants"

Another serious problem for the Turkish growers is wilt disease causing soil borne pathogens. *Fusarium oxysporum f sp. melongenae* is the most frequently isolated species on eggplant in Turkey (Altinok, 2013). This disease is affects eggplant cultivations in both greenhouses and open field cultivations (Mutlu et al., 2008). Most of the important varieties including hybrids are susceptible to Fusaium wilt (Altinok et al., 2013; Altinok et al., 2014). The most effective way to control the disease is to use resistant varieties. This study was aimed to determine the reaction of some cultivated eggplant genotypes and its wild species, in view to detect resistance trait, its inheritance and find molecular markers. The study was carried out between the years 2003 and 2006 in greenhouses and laboratories of Bati Akdeniz Agricultural Research Institute. In this project, 25 different eggplants including domestic and foreign origin's genotypes, some pure lines and wild genotypes have been tested. The findings showed that some of the genotypes in the cultivars tested, both wild and cultivar forms, were found to be resistant (Boyaci et al., 2012). The reactions of 15 different genotypes having some resistance and the susceptible eggplants with 12 different isolates of Fusarium were tested in order to identify genotype x isolate interactions. According to the results, the isolates used in the experiment were separated in two different groups as low and high virulence (Boyaci et al., 2013a). The other study of this project was to investigate the inheritance of resistance by using the reciprocal crosses between the resistant genotypes (LS 1934 and LS 2436), which belong to the species Solanum melongena and to the susceptible pure line NSFB-99. The findings have shown that inheritance was monogenic dominant (Boyaci et al., 2011b). In this project, a genetic linkage map has been constructed based on RAPD markers using F_2 and BC_1 progenies from a cross. The H-12 primer was determined as a marker with a distance of 2.6 cM to the resistant locus. Also, the same segregating population was used on another project performed in 2005-2006 with the aim to develop SCAR markers associated to the resistance. Two molecular markers linked to the resistance were mapped at a distance of 1.2 cM from. These markers were useful tools for MAS (Mutlu et al., 2008).

"Breeding of F1 Hybrid Eggplant Variety Suitable For Protected Cultivation" under the Project "The Cooperation of Public-Private Sector in Development of Turkey F_1 Hybrid Vegetable Varieties and Seed Production"

Vegetable breeding studies were conducted quite late in Turkey. As most institutions and private seed companies did not have enough infrastructure, laboratory equipments nor professionals, it was not possible to develop domestic vegetable hybrids. This project was launched to improve local hybrid varieties on eggplant, tomato, pepper, cucumber, melon, squash and watermelon by the Ministry of Agriculture Food and Livestock, State Planning Organization, by joining public institutes, universities and private firms in 2004. The aim of this project was to share resources owned by all the institutions and professionals involved in vegetable breeding to save money and time. Five public institutions, seven universities and 34 seed companies were joined together in this project. This was the first national collaborative effort on vegetable breeding in Turkey and it was carried out under the coordination of Bati Akdeniz Agricultural Research Institute between 2004 and 2010. The project tasks took in consideration both the seed company demands and the important problems faced by growers during for the eggplant cultivation. The main areas were resistance to biotic and abiotic stress, high yield and quality for the different fruit types. Breeding programs aimed to develop the F_4 materials which were released to seed companies to develop their own F_1 hybrids.

Particular attention was payed to breeding activity to improve the resistance to salt stress. In fact, especially in the cultivations along the Mediterranean coast the intensive cultivation causes soil and ground waters pollution due to excessive use of chemicals and employment of slightly salty water for irrigation. These effects are particularly deleterious on eggplant seedling with respect to mature plants. Consequently, 132 eggplant F_4 lines with superior characteristics of have been developed in four different fruit types following selection for high yield in winter season, Fusarium resistance and salt stress tolerance. With the completion of the project, the number of breeding lines reached from

167 to 609. Technical staffs of the private sector were trained on eggplant breeding and disease resistance tests. Technical greenhouse exhibitions were organized to show and transfer the improved eggplant lines to the private sector. This project has led to the arrangement of the two cooperation agreements with seed companies.
Batı Akdeniz Agricultural Research Institute (BATEM) collaboration with private seed sector under two breeding projects.

"Improvement of Resistant Eggplant Lines in the F_4 Stage to *Fusarium oxysporum f. sp. melongenae*"
Fusarium oxysporum f. sp. melongenae, the soil-borne pathogen causing wilt disease is one of the major factors limiting eggplant production in Turkey. This disease can cause significant yield losses in both the open field and greenhouse cultivation. Unfortunately, resistant eggplant varieties against Fusarium wilt were not available in commercial eggplant cultivars. This project was carried out in collaboration with seven private seed companies between 2005 and 2008. Backcross method was used as breeding strategy. With this project, 205 Fusarium resistant inbred lines at the BC_2F_4 stage were transferred to the private companies. Thanks to the resistant material, these companies were able to improve their commercial varieties in accordance with the Turkish market demands in a short time.

"Improvement of eggplant lines to resistant *Fusarium oxysporum f. sp. melongenae* and to tolerant *Verticillium dahliae*'
According to a survey report, 40%, 60% and 50% of the eggplant cultivation at Antalya, Mersin and Samsun were infested with wilting diseases at respectively. Co-presence of both wilting diseases was determined to be about 20% in Antalya (Altinok et al., 2012). Moreover, infection by both Fusarium and Verticillium on the same plant was also detected. In Turkey, *Verticillum dahliae* is the second most important soil borne pathogen that causes wilt disease in eggplants after Fusarium. Its attack has been observed both in the open field and in the greenhouse. Pathogenic *Verticillium dahliae* was isolated from wilted eggplants in survey studies conducted in southern Turkey (Dervis et. al., 2009). Since resistant cultivars against this disease were not available, three specialized seed companies asked BATEM to select resistant inbreed lines for two diseases. The activity was carried out between 2009 and 2013. Backcrossing program to intogress resistance genes have been used. While the molecular method was performed evaluation of Fusarium resistance, classical method performed for the Verticillium resistance evaluation. Fifty Fusarium resistant and Verticillium tolerant inbreed lines were transferred to the project partners.

"Improvement of F_1 Hybrid Vegetable Varieties and Qualified Line"
Although the hybrid vegetable seeds begun in the 1980s, and many commercial hybrid vegetable varieties were registered by the public and private sectors in the last decade. Nevertheless, most of these varieties did not have the required qualities. This project was financially supported by the Scientific and Technological Research Council of Turkey between the years 2010-2014. Suitability to market demands, high quality and yield, tolerance/resistance to biotic and abiotic stress conditions were the goals of the project to develop the seed sector in Turkey. Thus, it would contribute to the economy. In this main project, lines and varieties with better nutritional fruit composition, taste and color, and tolerant or resistant to biotic and abiotic stress have been developed in tomato, pepper, eggplant, cucumber, melon, watermelon and zucchini adapted for Turkish growers needs.

The studies were performed in three steps which include biotic and abiotic stress and market demands in eggplant. The study was to improve the quality of the lines and the F_1 hybrid varieties resistant to Fusarium. The resistant cylindrical typed inbred lines in the F_4 stage developed in our previous work were used to obtain improved F_1 hybrid variety. Also, oval typed eggplant lines were improved for resistance to Fusarium. (Boyaci et al., 2013b). Both classical and molecular methods were used to determine the reaction of backcross progenies to the disease in breeding studies. Third study was to improve the quality (fruit color and shape) of the lines and the F_1 hybrid varieties for greenhouse cultivation. The obtained results from the studies include one cold tolerant line, 25 lines and two varieties resistant against Fusarium, 30 lines and two varieties having improved quality. A Fusarium resistant long type hybrid variety was registered with the name "Yıldırım", it is first the Fusarium

resistant eggplant hybrid variety in Turkey. Plant is vigorous and highly adaptable. With a high yield during the growing period. Fruits keep their dark color in the coldest periods. Fruit setting is not affected by temperature fluctuations. Fruit length is 22-24 cm with an average weight of 230 gr., suitable for export. It can also be grown in the open field. Some inbred lines were tested for resistance against cold stress by using several methods. It was determined that one of the line was highly tolerant (Tepe et al., 2013).

"Improvement of Qualified Genitors for Eggplant Breeding Programs and Seed Technology"
Because current trends can vary in the seed market, there is a need for new variety improvements to meet market demands. So, breeding studies need have dynamic structures. Gene pools used in the studies should include a wide range of genetic materials. Therefore, new materials have been added to the gene pool by continuous survey studies. In this project, survey studies were performed in a district that is a region important for eggplant diversification. All the regional materials were classified using both morphological and molecular methods. Collected genotypes have showed wide genetic diversity. They can be good source for future breeding studies because of their having potential value (Boyaci et al., 2015).

In additional study of this project was breeding of hybrid varieties, well adapted to environmental conditions like cold season and high yield. Inbred lines developed in a large F_2 population in previous work used in this study. A single plant selection process was performed from their phenotypic performance (plant growth vigor, earliness, hairiness, spines, fruit color, fruit shape and size, yield, seed containing etc.). Best selected lines were tested for general combining ability. The parents exhibited good general combining ability effects for all desirable characters were crossed in a diallel mating design. After agronomical evaluation in different locations an oval F_1 hybrid was obtained by using classical methods.., it was registered as "BATEM Filizi" in 25 November 2011 by Directorate of Seed Certification Centre, Republic of Turkey Ministry of Food, Agriculture and Livestock.
"BATEM Filizi" is suitable for growth in both greenhouse and open field conditions, highly adaptable to different conditions, the plant is very vigorous and gives high yield, the fruit shape is oval, shiny, black in color and have smooth skin, the flesh has good firmness and a creamy-green color, less tendency toward bitterness. It does not need any special cultivation conditions. This variety was transferred to commercial companies in order to meet the demands of both Turkish and foreign producers and consumers in May 2013 (Boyaci and Topcu, 2014).

Research Findings and Research Nomenclature
Eggplant breeding programs have been carried out intensively in Western Europe, India, China and Japan beside Turkey and many commercial F_1 hybrids have been developed in the last 40 years. However, there is still a need for new varieties.

Until today, a total of 256 inbred lines including 205 Fusarium resistant, fifty Fusarium resistant and Verticillium tolerant, one new hybrid variety named as "BATEM Filizi" were transferred to the seed sector by BATEM. The seed demands of Fusarium resistant hybrid variety "Yıldırım" are meet by the institute for the growers. A lot of scientific paper were produced from these studies for the breeders and scientists. The new projects under the cooperation of both universities and the seed sector will be continued in order to meet the needs of Turkish producers.

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References

1. Abak, K., Guler, H.,Y. (1994). Pollen fertility and the vegetative growth of various eggplant genotypes under low temperature greenhouse conditions. Solanaceae in Mild Winter Climates, *Acta Horticulturae, 366: 85-91.*
2. Altinok, H.H., Boyacı, H.F., Topçu, V. (2012). Prevalence of Fusarium and Verticillium wilts in greenhouse eggplant production areas of Antalya, Mersin and Samsun provinces and geographical distribution of the virulence of the isolates. *Atatürk University Journal of the Agricultural Faculty, 43 (2): 107-115 (In Turkish).*
3. Altinok, H.H. (2013). Fusarium species isolated from common weeds in eggplant fields and symptomless hosts of *Fusarium oxysporum* f. sp. *melongenae* in Turkey. *Journal of Phytopathology, 161(5): 335-340.*
4. Altinok H.H., Can, C., Boyaci, H.F., Topcu, V. (2013). Evaluation of Fusarium wilt resistance among the accessions of eggplant (*Solanum melongena* L.), 12th European Fusarium Seminar. Fusarium-Mycotoxins, Taxonomy, Genomics, Biosynthesis, Pathogenicity, Resistance, Disease Control, Bordeaux, FRANCE, 12-16 May 2013, p:172.
5. Altinok, H.H., Can, C., Boyaci, H.F., Topcu, V. (2014). Genetic variability among breeding lines and cultivars of eggplant against *Fusarium oxysporum* f. sp. *melongenae* from Turkey. *Phytoparasitica, 42(1): 75-84.*
6. Boyaci, H.F., Oguz, A., Unlu, M., Denizer, B., Abak, K. (2009a). Growth, pollen quantity and quality and fruit characteristics of some parthenocarpic and non-parthenocarpic eggplants in unheated greenhouse. *Acta Horticulturae, 807(1):239-244. ISSN: 0567-7572.*
7. Boyaci, H. F., Oguz, A., Unlu, M., Eren, A., Topcu, V., Erkal, S. (2009b). Relationship between some parameters of vegetative and generative developments of parthenocarp and nonparthenocarp eggplants. *Derim, 26(2): 28-39. ISSN 1300-3496, (In Turkish).*
8. Boyaci, H.F., Oguz, A., Yazici, K.M., Eren, A. (2011a). The efficacy of endogenous gibberellic acid for parthenocarpy in eggplant (*Solanum melongena* L.). *African Journal of Biotechnology, 10(34): 6522-6528. ISSN: 1684-5315.*
9. Boyaci, H.F, Unlu, A, Abak, K. (2011b). Genetic analysis of resistance to wilt caused by Fusarium (*Fusarium oxysporum melongenae*) in eggplant (*Solanum melongena*). *Indian Journal of Agricultural Sciences, 81(9):26-29. ISSN: 0019-5022.*
10. Boyaci, H.F., Unlu, A., Abak, K. (2012). Screening for resistance to *Fusarium* Wilt of some cultivated eggplant and wild *Solanum* accessions. *Acta Horticulturae 935(1): 23-27. ISSN: 0567-7572.*
11. Boyaci, H.F., Gumrukcu, E., Topcu, V., Abak, K. (2013a). Reaction of some resistant and susceptible eggplant genotypes to different isolates of Fusarium. Breakthroughs in the Genetics and Breeding of Capsicum and Eggplant. XV EUCARPIA Meeting on Genetics and Breeding of Capsicum and Eggplant Torino, Italy 2 – 4 September, p: 675-678.
12. Boyaci, H.F., Gumrukcu, E., Topcu, V., Unlu, A., Oten, M. (2013b). Improvement of resistant eggplant lines against Fusarium (*Fusarium oxysporum* Schlecht. f. sp. *melongenae).* Breakthroughs in the Genetics and Breeding of Capsicum and Egpplant. XV EUCARPIA Meeting on Genetics and Breeding of Capsicum and Eggplant Torino, Italy 2 – 4 September, p: 289-294.
13. Boyaci H.F, Topçu, V. (2014). Development of eggplant hybrid cultivar 'BATEM FILIZI' and determination of yield performance. *Derim, 31(2): 11-22.*
14. Boyaci, H.F., Topcu, V., Tepe, A., Yildirim, I.K., Oten, M., Aktas, A. (2015). Morphological and Molecular Characterization and Relationships of Turkish Local Eggplant Heirlooms. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 43(1): 100-107.*
15. Dervis, S., Yetisir, H., Yıldırım, H., Tok, F. M., Kurt, S., Karaca, F. (2009). "Genetic and pathogenic characterization of *Verticillium dahliae* isolates from eggplant in Turkey". *Phytoparasitica, 37(5): 467–476.*
16. Ekiz, H., Boyaci, H.F. (2001). Pepper and eggplant varieties in greenhouses on the coast of mediterranean in Antalya. XIth Meeting on Genetics and Breeding of Capsicum and Eggplant, 9-12 April, Antalya, p: 241-245.

17. FAO (2016). Agriculture Production Data. [Online] Available at: http://faostat3.fao.org/home/E[Accessed 15 February 2016].
18. Mutlu N., Boyacı, F.H., Göçmen, M., Abak, K. (2008). Development of SRAP, SRAP-RGA, RAPD and SCAR markers linked with a *Fusarium* wilt resistance gene in eggplant. *Theoretical and Applied Genetics, 117:1303–1312*.
19. Ozalp, R. (2005). The general evaluation of the vegetable seeding in Turkey. 2nd Turkey Seed Congress. 09-11 November 2005, Adana. p:15-23 (In Turkish).
20. Ozalp, R., Çelik, İ., Eren, A. (2014). The advances of vegetable seed sector in Turkey (2002–2013). 5th Turkey Seed Congress. 19-23 October 2014, Diyarbakır. p: 261-267 (In Turkish).
21. Ozcelik, N., Firat, A.F., Ekiz, H., Unsal, M., Ozturk, A., Boyaci, H.F. (2002). Improved hybrid vegetable varieties at citrus and greenhouse research Institute in Antalya. Turkey 1st Seed Congress, 11-13 September, İzmir/Turkey, p:121-126 (In Turkish).
22. Tepe, A., Gözen, V., Ünlü, A., Boyacı, H.F., Topçu, V., 2013. Performance of some eggplant genotypes under cold stress. International Plant Breeding Congress 10-14 November 2013, Antalya/TURKEY, p:510.
23. TSI (2016). Crop production statistics. Turkish Statistical Institute. [Online] Available at: http://www.tuik.gov.tr/PreTablo.do?alt_id=1001[Accessed 15 February 2016].