International Journal of Plant & Soil Science

32(14): 44-50, 2020; Article no.IJPSS.61667
ISSN: 2320-7035

Genetic Variability in Summer Brinjal (*Solanum melongena* L.)

Surabhi Sangam[1], Kamal Kant[1], Shirin Akhtar[1*], Neelu Kumari[1], Tirthartha Chattopadhyay[2] and Randhir Kumar[1]

[1]Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur – 813210, India.
[2]Department of Plant Breeding and Genetics, Bihar Agricultural University, Sabour, Bhagalpur – 813210, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author SS carried out the experiment in field and laboratory, wrote the first draft of the manuscript. Author KK helped in literature searches and crop management. Author SA formulated the study, managed the crop, performed the statistical analysis, wrote the protocol. Author NK helped in field and laboratory data recording. Author TC helped in literature searches and editing of manuscript. Author RK managed the crop. All authors have read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2020/v32i1430367
Editor(s):
(1) Marco Trevisan, Catholic University of the Sacred Heart, Italy.
Reviewers:
(1) Dirceu Guilherme de Souza Ramos, Universidade Federal de Mato Grosso, Brazil.
(2) Krishna Dhakal, Tribhuvan University, Nepal.
Complete Peer review History: http://www.sdiarticle4.com/review-history/61667

Original Research Article

Received 08 August 2020
Accepted 13 October 2020
Published 13 November 2020

ABSTRACT

Twenty two brinjal (*Solanum melongena* L.) genotypes were collected and grown in summer season and variability estimates were studied for twenty two different quality, yield, its attributing traits. High genotypic and phenotypic coefficient of variation was obtained for characters like length of style, fruit girth, average fruit weight, number of fruits per plant, yield per plant, total yield per hectare, total sugar, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenolic content and polyphenol oxidase. Heritability and genetic gain as percent of mean was observed to be high for characters such as plant height, number of primary branches, length of style, fruit length, fruit girth, average fruit weight, number of fruit per plant, yield per plant, total yield per hectare, TSS, total sugar, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenolic content and polyphenol oxidase. High heritability coupled with high

**Corresponding author: E-mail: shirin.0410@gmail.com;*

predicted genetic gain suggests for selection based on these traits for enhancement of yield and quality.

Keywords: Genotypic coefficient of variation; genetic advance; heritability; phenotypic coefficient of variation.

1. INTRODUCTION

Brinjal (*Solanum melongena* L.) is a prime member of family Solanaceae with basic chromosome number 2n=24 [1]. It is a versatile crop grown entire year in the tropics as well as in sub-tropical regions and in temperate region it is grown during the summer season. Brinjal is rich in nutrients as well as secondary metabolites having health benefits [2]. Brinjal is a good source of nutrients such as folate, ascorbic acid, niacin, vitamin B6, pantothenic acid, vitamin K, iron, magnesium, manganese, phosphorus, potassium, and copper [3]. It contains high amount of total water soluble sugars, free reducing sugars, amide proteins and other nutrients besides having low fat and high dietary fiber [4]. It is known to be a good remedy for liver complaints and toothache [5]. White brinjal is considered advantageous for patients with diabetes due to low sugar and high chlorogenic acid, which also contributes to the antioxidant properties and anti-cancer activities of brinjal [6]. Brinjal is ranked among top ten vegetables to scavenge oxygen radical species because of the presence of phenolic compounds [7]. Bajaj et al. [8] mentioned higher amount of free reducing sugars, anthocyanin, phenols, glycoalkaloids (such as solasodine), dry matter, and amide proteins in long fruited brinjal cultivar, whereas the oblong-fruited eggplant were reported for high total soluble sugar content. Fruits having high dry matter content with a low level of phenolics are preferred for processing. High polyphenol oxidase activity attributes to discolouration and are of low priority for processing. Jukanti and Bhatt's report [9] indicates role of polyphenol oxidase in undesirable enzymatic browning of brinjal fruit and besides plant defense.

The optimum temperature for its fruit set is 18-21°C [10] but sometimes when average day temperature rise to 35°C or above, the fruit setting in the crop is hampered. Summer crop faces yield loss mainly due to the environmental factors *viz.*, high temperature and strong dry winds [11]. These factors directly affect the flower setting and at the end, results in flower and fruit drop which in turns deduct the final yield. Genetic screening for identifying suitable genotypes for summer season is required and the genotypes should have ample variability for initiating a breeding programme. High variability among yield and yield attributing traits and quality parameters favors selection of elite genotypes. Moreover, high heritability along with high genetic gain as percent of mean gives a clearer picture for selection procedure as it directs towards contribution of additive gene in expression of any trait. In the current investigation, genetic variability was studied in twenty two brinjal genotypes differing in colour, shape and size grown in summer season.

2. MATERIALS AND METHODS

Total twenty-two brinjal genotypes were collected from all over India and maintained at Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour. These genotypes were grown in summer season of 2019 in the experimental plot of Vegetable research farm, Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour in Randomized Block Design with three replications. Inter row distance was maintained to 75 cm whereas inter-plant distance was 60 cm. All the necessary measures and precautions regarding crop husbandry, intercultural operations, irrigation etc. were maintained to raise a good crop.

Various observations recorded during the study were plant height, plant spread, number of primary branches, days to 1^{st} flowering, days to 50% flowering, days to 1^{st} fruit set, pollen viability, length of style, fruit length, fruit girth, average fruit weight, number of fruit per plant, yield per plant, total yield per hectare, total soluble solids (TSS), total sugar, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenolic content and polyphenol oxidase. Total soluble solid (TSS) was estimated using an ERMA manual refractometer (0-32 ºBrix). Total sugar and reducing sugar content of the pulp (Fehling's method) was analyzed by Lane-Eynon method [12] using Fehling solutions as a reagent and the results were expressed in percentage. The ascorbic acid content in the fresh fruits was determined by the volumetric method [13]. Titrable acidity was estimated as per Ranganna [14]. Total phenolics were estimated spectrophotometrically using Folin–Ciocalteu reagent [15] and noting the absorbance at 765nm and judging the observations against standard catechol solution. The total antioxidant capacity was estimated as per the method of Apak et al. [16] and depicted by cupric ion reducing antioxidant capacity (CUPRAC). Polyphenol oxidase activity was estimated as per Jiang et al. [17].

The analysis of genotypic and phenotypic coefficient of variance was done as per Comstock and Robinson [18]. On the other hand, estimation of heritability was done according to Lush [19] and predicted genetic advance as per method suggested by Lush [20] and Johnson et al. [21].

3. RESULTS AND DISCUSSION

Analysis of variance revealed significant contrast among yield and yield associated characters in the twenty-two different genotypes studied which suggested the validity of the experiment conducted (Table 1). It was observed that there was highly significant difference among all the growth characters, reproductive characters, fruit morphological characters, yield and attributing traits as well as quality characters under study. The analysis of variance of twenty two characters in consideration suggested a significant difference among the genotypes under study which suggested an ample scope for selection. Muniappan et al. [22], Kumar [23], Nayak and Nagre [24], Akhtar et al. [25] and Banerjee et al. [26] also reported higher variability indicating ample opportunity for selection among diverse genotypes.

Table 1. Mean sum of squares for genotype, replication and error of twenty two traits in twenty two different brinjal genotypes

Characters	Mean sum of square		
	Genotype (df = 21)	Replication (df = 2)	Error (df = 44)
Plant height (cm)	965.57**	286.32	115.13
Plant spread (cm)	406.14**	75.46	93.33
Number of primary branches	2.12**	0.35	0.21
Days to 1st flowering	50.12**	49.95	17.02
Days to 50% flowering	43.98**	22.61	7.44
Days to 1st fruit set	40.14**	19.14	13.69
Pollen viability	89.46**	8.83	8.16
Length of style (cm)	0.18**	0.01	0.01
Fruit length (cm)	2.92**	0.62	0.22
Fruit girth (cm)	29.43**	2.05	0.94
Average fruit weight (g)	563.35**	38.67	21.30
Fruit number/plant	167.84**	1.40	2.08
Yield/plant (g)	173934.98**	9449.67	3356.37
Total yield (q/ha)	11197.85**	243.55	218.18
TSS (°Brix)	1.65**	0.31	0.19
Total sugar (%)	4.56**	0.13	0.05
Reducing sugar (%)	0.57**	0.00	0.02
Titrable acidity (%)	0.19**	0.01	0.01
Ascorbic acid (mg/100g FW)	0.48**	0.05	0.02
Total antioxidant capacity (µg Trollox milli equivalent/g FW	0.49**	0.02	0.02
Total phenolic content (CE mg/100gm)	61.35**	4.29	1.70
Polyphenol oxidase	175.41**	25.00	8.26

Highly significant (**) at P ≤ 0.01

The extent of variability among the genotypes for different characters in consideration in terms of GCV, PCV, heritability, genetic advance and genetic gain as percent of mean has been summarized in the Table 2. Sivasubramanian and Madhavamenon [27] has arranged estimate of GCV and PCV into three distinct classes, *i.e.*, low (<10%), moderate (10-20%) and high (>20%) and this classification has been adopted here.

Table 2. Estimates of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), heritability, genetic advance and genetic gain as percent of mean

Traits	PCV	GCV	Heritability	GA	GA as %of mean
Plant height (cm)	19.34	16.18	70.02	28.93	27.89
Plant spread (cm)	14.87	10.64	51.25	14.95	15.70
Number of primary branches	14.68	12.62	73.94	1.41	22.36
Days to 1st flowering	10.14	6.22	37.64	4.15	7.86
Days to 50% flowering	7.63	5.94	60.74	5.58	9.54
Days to 1st fruit set	7.63	4.67	37.48	3.70	5.89
Length of style (cm)	34.82	33.38	91.89	0.48	65.91
Pollen viability	10.70	9.38	76.87	10.05	16.94
Fruit length (cm)	17.11	15.24	79.35	1.74	27.97
Fruit girth (cm)	26.69	25.41	90.61	6.04	49.82
Average fruit weight (g)	31.59	29.88	89.45	28.00	58.21
Fruit number/plant	79.12	77.67	96.37	16.07	157.08
Yield/plant (g)	59.67	57.99	94.43	510.28	116.07
Total yield (q/ha)	59.69	57.98	94.37	129.43	116.04
TSS (°Brix)	16.02	13.51	71.15	1.21	23.48
Total sugar (%)	56.20	55.29	96.77	2.49	112.04
Reducing sugar (%)	32.35	30.89	91.14	0.84	60.75
Titrable acidity (%)	25.70	24.25	89.01	0.48	47.13
Ascorbic acid (mg/100g FW)	23.98	22.67	89.39	0.76	44.15
Total antioxidant capacity (µg Trollox milliequivalent/g FW)	22.88	21.55	88.68	0.76	41.80
Total Phenolic Content (CE mg/100gm)	27.12	25.98	91.78	8.79	51.27
Polyphenol Oxidase	25.00	23.26	86.53	14.29	44.57

The genotypic coefficient of variation was high for number of fruits per plant (77.67%), yield per plant (57.99%), total yield per hectare (57.98%), total sugar (55.29%) and also length of style, fruit girth, average fruit weight, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenolic content and polyphenol oxidase and moderate for the characters such as, plant height, plant spread, number of primary branches, fruit length and TSS.

The phenotypic coefficient of variation was high for the traits like number of fruits per plant (79.12%), yield per plant (59.67%), total yield per hectare (59.69%), as well as length of style, fruit girth, average fruit weight, total sugar, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenolic content and polyphenol oxidase and moderate for the characters plant height, plant spread, number of primary branches, days to 1^{st} flowering, pollen viability, fruit length and TSS.

Similar findings are supported by Singh and Kumar [28] for average fruit weight and number of fruit per plant; Samlindsujin et al. [29] for fruit girth, average fruit weight and number of fruits per plant; Parvati et al. [30] for average fruit weight, number of fruits per plant, reducing sugar, ascorbic acid and total phenolic content; Shilpa et al. [31] for fruit yield from each plant, weight of fruits and height of plant. Pathania et al. [32] reported similar trends for fruit length, fruit girth, average fruit weight, number of fruits per plant, fruit yield per plant, ascorbic acid and total phenolic content; Banerjee et al. [26] for fruit length, fruit girth, average fruit weight, number of fruit per plant.

For each character, slightly higher values of phenotypic coefficient of variation over genotypic coefficient of variation were noted indicating major effect of genes on the phenotypic expression rather than the environmental effects. Banerjee et al. [26] earlier suggested that there is a genetic contribution to the characters showing high phenotypic expression. Hence, characters favouring similar trend can be useful for effective selection of elite genotype.

Heritability gives the estimate of the extent of phenotypic variation due to the effect of fixable component of genetic variance. Johnson et al. [21] had arbitrarily categorized estimates of heritability as low (< 30%), moderate (30-60%) and high (> 60%), which has been adopted here. High heritability was recorded for plant height (70.02%), number of primary branches (73.94%), days to 50% flowering (60.74 %), length of style (91.89%), pollen viability (76.87 %), fruit length (79.35%),fruit girth (90.61%), average fruit weight (89.45%), number of fruits per plant (96.37%), yield per plant (94.43%), total yield per hectare (94.37%), TSS(71.15%), total sugar (96.77%), reducing sugar (91.14%), titrable acidity(89.01%), ascorbic acid(89.39%), total antioxidant capacity (88.68%), total phenolic content (91.78%) and polyphenol oxidase (86.53%) and moderate for the characters plant spread (51.25%), days to 1st flowering (37.64%) and days to 1st fruit set (37.48 %).

Genetic advance is the measure of genetic gain under selection which directly depends on the extent of genetic variability of any population, while genetic advance as a percent of mean gives the predicted genetic advance. Genetic advance as percent of mean has been categorized as low (< 10%), moderate (10-20%) and high (>20%) by Johnson et al. [21]. The genetic gain was found to be high for plant height (27.89%), number of primary branches (22.36 %), length of style (65.91 %), fruit length (27.97 %), fruit girth (49.82 %), average fruit weight (58.21 %), number of fruits per plant (157.08 %), yield per plant (116.07 %), total yield per hectare (116.04 %), TSS(23.48 %), total sugar (112.04 %), reducing sugar (60.75 %), titrable acidity (47.13 %), ascorbic acid(44.15 %), total antioxidant capacity (41.80 %), total phenolic content (51.27 %) and polyphenol oxidase (44.57 %). Moderate genetic advance was noted for plant spread (15.70 %) and pollen viability (16.94 %). Genetic advance was noted high for plant height (28.93 %), average fruit weight (28 %), yield per plant (510.28 %) and total yield per hectare (129.43 %) whereas moderate values for plant spread (14.95 %), pollen viability (10.05 %) and number of fruits per plant (16.07 %) was obtained.

The selection process can become more accurate if selection is made considering heritability and genetic advance together. High heritability along with high genetic advance is considered best for selection procedure due to preponderance of additive gene action. Conversely, low heritability along with low genetic advance show prevalence of environmental effect suggesting selection to be ineffective. High heritability along with low genetic advance due to non additive gene action suggest for misleading selection, whereas low heritability coupled with high genetic advance suggest high environmental effects rather additive gene action which can lead to ineffective selection in early generations. Besides, genetic advance is generally high with the characters possessing high heritability. Therefore, such characters are considered best for selection. In the present study, plant height, average fruit weight, yield per plant and total yield per hectare exhibited high genetic advance along with high estimates of heritability. Moderate values were recorded for plant spread, pollen viability and fruit per plant and rest characters showed low genetic advance. The characters such as plant height, number of primary branches, length of style, pollen viability, fruit length, fruit girth, average fruit weight, number of fruit per plant, yield per plant, total yield per hectare, TSS, total sugar, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenolic content and polyphenol oxidase turned out to exhibit high heritability accompanying high predicted genetic gain as percent of mean. Similar findings for fruit length, fruit girth, average fruit weight, number of fruits per plant, fruit yield per plant, ascorbic acid and total phenolic content were reported by Pathania et al. [32]; for fruit length, fruit girth, average fruit weight, number of fruit per plant by Banerjee et al. [26]; for plant height, fruit length, fruit girth, average fruit weight, number of fruit per plant and yield per plant by Shilpa et al. [31]. Kumar et al. [23] reported similar findings for length of fruit, number of fruits from each plant, total phenolic content and yield of fruit per plant recorded high value of genetic variability together with heritability and genetic advance. High heritability combined with high genetic advance as percent of mean for yield per plant was supported by previous works of Munniappan et al. [22], Samlindsujin et al. [29] and Patel et al. [33].

4. CONCLUSION

High variability was observed for the twenty-two different morphological, reproductive, yield and quality characters. Genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic gain as percent of mean were reported high for most of the characters *viz*., length of style, fruit girth, average fruit weight, number of fruits per plant, yield per plant, total yield per hectare, total sugar, reducing sugar, titrable acidity, ascorbic acid, total antioxidant capacity, total phenol content and polyphenol oxidase. So, these characters can be considered while selecting any high yielding genotype for summer season and selection based on these traits would be effective in developing improved genotype for summer season.

ACKNOWLEDGEMENT

The authors acknowledge the Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour for provision of seeds and infrastructure for carrying out the research work. The authors are also thankful to the BAU non plan project SNP/CI/Kh/2016-12 for financial support in carrying out the research work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Doganlar S, Frary A, Daunay MC, Lester RN and Tanksley SD A Comparative Genetic Linkage Map of Eggplant (Solanum melongena) and Its Implications for Genome Evolution in the Solanaceae Genetics. 2002;161:1697–1711.
2. Daunay MC. Eggplant. In: Prohens J, Nuez F. (eds) Vegetables II. Handbook of Plant Breeding, vol 2. Springer, New York, NY. 2008. Available:https://doi.org/10.1007/978-0-387-74110-9_5.
3. Naeem MY, Ugur S. Nutritional Content and Health Benefits of Eggplant. Turkish Journal of Agriculture - Food Science and Technology. 2019;7(sp3):31-36.
4. Anonymous. United States Department of Agriculture .Washington, D.C., United States; 2009.
5. Dakone D, Awoke G. A review on ethnomedicinal use, nutritional value, phytochemistry and pharmacological characteristics of Solanum incanum L. An important medicinal plant. International Journal of Scientific and Technology Research. 2016, 5(6), 350-354.
6. Gonthier MP, Verny MA, Besson C, Remesy C, Scalbert A. Chlorogenic acid bioavailability largely depends on its metabolism by the gut microflora in rats. J. Nutr. 2003;133(6):1853–1859.
7. Cao G, Sofic E, Prior RL. Antioxidant capacity of tea and common vegetables. J. Agric. Food. Chem. 1996;44:3426-3431.
8. Bajaj KL, Kaur G, Chadha ML. Glycoalkaloid content and other chemical constituents of the fruits of some egg plant (*Solanum melongena* L.) varieties. Journal of Plant Foods. 1979;3(3):163-168.
9. Jukanti AK, Bhatt R Eggplant (*Solanum melongena* L.) polyphenol oxidase multi-gene family: A phylogenetic evaluation. Biotech. 2014;5(1):93–99.
10. Charles WB, Harris S. Effect of temperature on flower production and fruit set in tomato. Canadian J. Pl. Sci. 1972;52:497-06.
11. Singh N and Kalda TS. Brinjal, InText book of vegetables, tuber crops and spices (Eds) S. Thamburaj and N. Singh, ICAR, New Delhi; 2000.
12. AOAC. Official methods of analysis. Association of Official Analytical Chemists, Washington DC, USA; 2000.
13. AOAC Official methods of analysis. Association of Official Analytical Chemists, Washington DC, USA; 2001.
14. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw Hill Publishing Co. Ltd., New Delhi. 1986;190-210.
15. Singleton VL, Orthofer R, Lamuela RM. Analysis of total phenols other oxidation substrates and antioxidants by means of Folin–Ciocalteu reagent. Methods in Enzymology. 1999;152-178.
16. Apak R, Guclu K, Ozyurek M, Karademir SE. Novel total antioxidant capacity index for dietary polyphenols and vitamins C and E using their cupric ion reducing capabilities in the presence of neocuproine: CUPRAC method. Journal of Agricultural and Food Chemistry. 2004;52:7970-7981.
17. Jiang YM and Fu JR. Biochemical and physiological changes involved in browning of litchi fruit caused by water loss. The Journal of Horticultural Science and Biotechnology. 1999;74(1):43-46.
18. Comstock RE, Robinson HF. Genetic variability and correlation studies in muskmelon (*Cucumis melo* L.). Indian Journal of Agriculture Science. 1952;49:361-63.
19. Lush JL. Intro-site correlation and regression of off spring on corn as a method of estimating heritability of characters. Journal of Animal Science. 1940;33:293-301.
20. Lush JL. Heritability of quantitative traits in farm animals. Proceeding of 8th international congress genetic Hereditas, 1949;(Suppl.):336-357.
21. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental

variability in soybean. Agronomy Journal. 1955;47:314-18.
22. Muniappan S, Saravanan K, Ramya B. Studies on Genetic Divergence and Variability for Certain Economic Characters in Eggplant (*Solanum Melongena* L.). Electronic Journal of Plant Breeding. 2010;1(4):462-465.
23. Kumar SR, Arumugam T, Anandakumar CR, Premalakshmi V. Genetic variability for quantitative and qualitative characters in Brinjal (*Solanum melongena* L.). African Journal of Agricultural Research. 2013;8(39):4956-4959.
24. Nayak BR and Nagre PK. Genetic variability and correlation studies in brinjal (Solanum melongena L.). International Journal of Applied Biology and Pharmaceutical Technology. 2013;4: 211-215
25. Akhtar S, Solankey SS, Kumari R, Rani N. Crucial Reproductive Traits as Indices for Screening Brinjal(*Solanum melongena* L.) under High Temperature Stress. Indian Journal of Ecology, 2017; 44 (Special Issue-5): 331-336.
26. Banerjee S, Verma A, Bisht YS, Maurya PK, Jamir I, Mondal S, Bhattacharjee T, Chattopadhyay A. Genetic variability, correlation coefficient and path coefficient analysis in brinjal germplasm. International Journal of Chemical Studies. 2018;6(4):3069-3073.
27. Sivasubramanian S and Madhavamenon P. Combining ability in rice. Madras Agricultural Journal. 1973;60:419-421.
28. Singh O and Kumar J. Variability, heritability and genetic advance in brinjal. Indian Journal of Horticulture. 2005;62:265-267.
29. Samlindsujin G, Karuppaiah P, Manivannan K. Genetic variability and correlation studies in brinjal (*Solanum melongena* L.). Internat. J. Plant Sci. 2017;12(1):21-27.
DOI: 10.15740/HAS/IJPS/12.1/21-27
30. Parvati P, Jagadeesha RC, Satish D, Venkateshalu, Mesta RK. Genetic variability, Heritability, Genetic Advance and Genetic Diversity Analysis for Yield, Yield Related Components of Brinjal [*Solanum melongena* L.] Genotypes. International Journal of Genetics. 2018;10(6):460-463.
31. Shilpa BM, Dheware RM, Kolekar RB. Variability Studies in Brinjal (*Solanum melongena* L). International Journal of Bio-resource and Stress Management. 2018;9(5):576-579.
32. Pathania NK, Katoch DR, Chaudhary, Chandel KS. Genetic variability and association studies in eggplant. Abstract in International Conference on Vegetables, held at Bangalore, India. 2002;89.
33. Patel VK, Singh U, Goswami A, Tiwari SK, Singh M. Genetic variability, interrelationships and path analysis for yield attributes in eggplant. Environment & Ecology. 2017;35:877-880.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/61667