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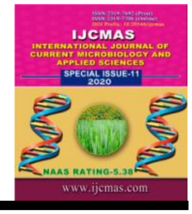

Original Research Article

Genetic Inheritance of Qualitative Traits in Brinjal (*Solanum melnogena* [L.])

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Keywords

Inheritance, Chi square, Complimentary gene action

A B S T R A C T

The experimental material comprised of eleven genotypes which includes three crosses of F_1, F_2 and five parents. All these eleven genotypes were planted during *kharif* 2019. Treatments comprised of five brinjal genotypes, three F_1 crosses with F_2 from three cross combinations. The five promising genotypes were selected based on the characters like plant height, plant spread, branching habit, fruit shape, size, colour and yield. The five brinjal genotypes Poona selection, Phule Harit, *Solanum sismbrifo*, *Solanum indicum*, Poona selection and *Solanum viarum* with their F_1 cross combinations and segregating F_2 material studied. The ratio of 9:3:4 and 15:1 for fruit shape; 9:3:4, 15: 1 and 9:7 for fruit colour and 3 : 1 for spines on the stem indicated complex nature of inheritance for these characters and the differences in segregation pattern might be due to the presence of variety number of genes among the parental lines used in the study. The singe dominant gene was responsible for inheritance of spines on the stem, and possibly two supplementary genes as well as two genes in duplicate fashion for fruit shape and two complimentary genes for fruit colour were observed in the present study.

Introduction

Brinjal or eggplant (*Solanum melongena* L.) is an important solanaceous crop of sub-tropics and tropics. The name brinjal is popular in Indian subcontinents and is derived from Arabic and Sanskrit whereas the name eggplant has been derived from the shape of the fruit of some varieties, which are white and resemble in shape to chicken eggs. Among the vegetables, brinjal is the most important crop being cultivated worldwide, except higher altitudes. In India, it plays a very vital role to ensure the nutritional security of the fast growing population. India being a centre of diversity for this crop (Genebus, 1962), provides a large amount of variation thereby giving a vast opportunity for its genetic improvement. Though a large number of cultivars have been developed through extensive research in past few decades, the popularities of these varieties may vary from region to region due to the demand for different culinary purposes and the consumer`s preference about the colour, size and shape of fruit. Its quick growth, short duration and photo insensitive nature; enable genetics and plant breeders to raise two crops in a year, which in turn, can accelerate the rate of important. For running systematic breeding programme in any crop plant, an understanding of the inheritance pattern of morphological characters is essential so that segregating population can be handled effectively. Brinjal genotypes available as germplasm collection at the Vegetable Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani have yet bean characterized for inheritance pattern of morphological characters. The present investigation was, therefore, carried out to determine inheritance of six morphological characters.

Materials and Methods

The experimental material comprised of eleven genotypes which includes three crosses of F_1, F_2 and five parents. All these eleven genotypes were planted during *kharif* 2019. Treatments comprised of five brinjal genotypes, three F_1 crosses with F_2 from three cross combinations. The five promising genotypes were selected based on the characters like plant height, plant spread, branching habit, fruit shape, size, colour and yield. The five brinjal genotypes Poona selection, Phule Harit, *Solanum sismbrifo, Solanum indicum,* Poona selection and *Solanum viarum* with their F_1 cross combinations and segregating F_2 material studied. The experimental material consists of eleven treatments i.e. Three crosses of F_1, F_2 and five parents, which were sown during *kharif* 2019 in randomized block design with three replications. The experiment was conducted at research farm, Department of Horticulture, VNMKV, Parbhani. One row of parent and F_1 and five rows of F_2 were spaced 75 cm apart with the distance between the plants of 60 cm. Seeds of each generation for all the crosses were sown initially in pots and 25-30 days old seedlings then were transplanted in the experimental field. The crop management practices were followed as per recommended schedule. All the plants in parental, F_1 and F_2 generations were used for recording the data on six characters viz., fruit shape, fruit colour and spiny leaf. The statistical analysis was based on counting and ratio. The goodness of fit between observed and expected segregating pattern in F_2 of different crosses was tested by using X^{2-} test

Results and Discussions

The present investigation was undertaken with a view to study the inheritance of some qualitative traits in brinjal. The results obtained on three traits are summarized and discussed hereunder.

Fruit shape

This trait is characterized by the long, oblong and round fruit shape.

Cross combination 1: Poona selection × *Solanum sismblifolium*

P1 (oblong) X P2 (Round)

⇩

F_1 (Oblong)

F2 segregation: 50 (Oblong): 16 (Round): 24 (Long)

Null hypothesis: the ratio of segregation of fruit shape in F2 is 9:3:4

Poona selection X *Solanum sismbifolium*							
Table 1.1. Chi square analysis of segregation of fruit shape trait							
Expected Ratio	Observed (O)	Expected E	D=O-E	D2	D2/E	Critical value of chi at df=2	p value at df=2
Long	50	50.63	-0.625	0.391	0.008	5.99	0.95-0.50
Round	16	16.88	-0.875	0.766	0.045		
Oblong	24	22.50	1.5	2.250	0.100		
				$\Sigma=X^2=$	0.153		

Phule harit x *Solanum indicum*							
Table 1.2. Chi square analysis of segregation of fruit shape trait							
Expected Ratio	Observed (O)	Expected E	D=O-E	D2	D2/E	Critical value of chi at df=1	p value at df=1
Long	83	84.375	-1.375	1.891	0.022	3.84	0.95-0.50
Round	7	5.625	1.375	1.891	0.336		
				Σ=X2=	0.359		

Poona selection X *Solanum viarum*							
Table 1.3. Chi square analysis of segregation of fruit shape trait							
Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=2	p value at df=2
Oblong	50	50.63	-0.625	0.391	0.0077	5.99	0.95-0.50
Round	16	16.88	-0.875	0.766	0.0454		
Long	24	22.50	1.5	2.250	0.1000		
				$\Sigma=X^2=$	0.1531		

Poona selection X *Solanum sismbifolium*

Table 2.1. Chi square analysis of segregation of fruit colour trait

Expected ratio	Observed (O)	Expected E	D=O-E	D2	D2/E	Critical value of chi at df=2	p value at df=2
purple with white strips	51	50.63	0.375	0.141	0.0028	5.99	0.95-0.50
dark purple with white strips	16	16.88	-0.875	0.766	0.0454		
Light purple	23	22.50	0.5	0.250	0.0111		
				Σ=X2=	0.0593		

Phule harit x *solanum indicum*

Table 2.2. Chi square analysis of segregation of fruit colour trait

Expected Ratio	Observed (O)	Expected E	D=O-E	D2	D2/E	Critical value of chi at df=1	p value at df=1
Green with white patch	84	84.375	-0.375	0.14	0.002	3.84	0.95-0.50
Greenish	6	5.625	0.375	0.14	0.025		
				Σ=X2=	0.027		

Poona selection x *solanum viarum*

Table 2.3 Chi square analysis of segregation of fruit colour trait

Expected Ratio	Observed (O)	Expected E	D=O-E	D2	D2/E	Critical value of chi at df=1	p value at df=1
purple with white strips	52	50.625	1.375	1.891	0.037	3.84	0.95-0.50
light purple with white strips	38	39.375	-1.375	1.891	0.048		
				Σ=X2=	0.085		

Poona selection X *Solanum sismbifolium*

Table 3.1 Chi square analysis of segregation of spiny and non-spiny stem trait

Expected Ratio	Observed (O)	Expected E	D=O-E	D2	D2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Present	67	67.5	-0.5	0.25	0.0037	3.84	0.95-0.50
1/4 spines Absent	23	22.5	0.5	0.25	0.0111		
				Σ=X2=	0.0148		

Phule harit x *Solanum indicum*

Table 3.2 Chi square analysis of segregation of spiny and non-spiny stem trait

Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Absent	66	67.5	-1.5	2.25	0.0333	3.84	0.95-0.50
1/4 spines Present	24	22.5	1.5	2.25	0.1		
				Σ=X2=	0.1333		

Poona selection X *Solanum viarum*

Table 3.3 Chi square analysis of segregation of spiny and non-spiny stem trait

Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Present	66	67.5	-1.5	2.25	0.033	3.84	0.95-0.50
1/4 spines Absent	24	22.5	1.5	2.25	0.100		
				Σ=X2=	0.133		

Poona selection X Solanum sismbifolium

Table 3.4 Chi square analysis of segregation of spiny and non-spiny leaf traits

Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Present	67	67.5	-0.5	0.25	0.0037	3.84	0.95-0.50
1/4 spines Absent	23	22.5	0.5	0.25	0.0111		
				Σ=X2=	0.0148		

Phule harit X *Solanum indicum*

Table 3.5 Chi square analysis of segregation of spiny and non-spiny leaf traits

Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Absent	68	67.5	0.5	0.25	0.0037	3.84	0.95-0.50
1/4 spines Present	22	22.5	-0.5	0.25	0.0111		
				Σ=X2=	0.0148		

Poona selection X Solanum viarum

Table 3.6 Chi square analysis of segregation of spiny and non-spiny leaf traits

Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Present	67	67.5	-0.5	0.25	0.0037	3.84	0.95-0.50
1/4 spines Absent	23	22.5	0.5	0.25	0.0111		
				Σ=X2=	0.0148		

Poona selection X *Solanum sismbifolium*							
Table 3.7 Chi square analysis of segregation of spiny and non-spiny calyx trait							
Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Present	66	67.5	-1.5	2.25	0.033	3.84	0.95-0.50
1/4 spines Absent	22	22.5	-0.5	0.25	0.011		
				Σ=X2=	0.044		

Phule harit X *Solanum indicum*							
Table 3.8 Chi square analysis of segregation of spiny and non-spiny calyx trait							
Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Absent	67	67.5	-0.5	0.25	0.0037	3.84	095-0.50
1/4 spines Present	23	22.5	0.5	0.25	0.0111		
				Σ=X2=	0.0148		

Poona selection *X Solanum viarum*							
Table 3.9 Chi square analysis of segregation of spiny and non-spiny calyx trait							
Expected Ratio	Observed (O)	Expected E	D=O-E	D^2	D^2/E	Critical value of chi at df=1	p value at df=1
3/4 spines Present	66	67.5	-1.5	2.25	0.0333	3.84	095-0.50
1/4 spines Absent	22	22.5	-0.5	0.25	0.0111		
				$\Sigma=X^2=$	0.0444		

The χ2 value (0.15) has been found to be lesser than the critical χ^2 value at df=2. Besides the p at df=2 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, i.e. ratio of 9:3:4 is accepted for the trait in the cross combination. Fruit shape is controlled by two genes and supplementary gene action is involved in the expression of the character. Whereas Similar results were reported by Riplda *et al.*, (2012), Patidar (2015), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Cross combination 2: Phule Harit X *Solanum Indicum*

P1 (Long) X P2 (Round

⇩

F_1 (Long)

F2 segregation: 83 (Long): 7 (Oblong)

Null hypothesis: the ratio of segregation of fruit shape in F2 is 15:1.

The χ2 value (0.35) has been found to be lesser than the critical χ2 value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, i.e. ratio of 15:1 is accepted for the trait in the cross combination. Hence, fruit shape is controlled by two genes and duplicate dominant gene action is involved in the expression of the character. Whereas Similar results were reported by Arora *et al.*, (2008), Riplda *et al.*, (2012), Patidar (2015), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Cross combination 3: Poona selection X *Solanum viarum*

P1 (Oblong) X P2 (Round)

⇩

F_1 (Oblong)

F2 segregation: 50 (Oblong): 16 (Round): 24 (Long)

Null hypothesis: the ratio of segregation of fruit shape in F2 is 9:3:4

The χ2 value (0.15) has been found to be lesser than the critical χ2 value at df=2. Besides the p at df=2 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, i.e. ratio of 9:3:4 is accepted for the trait in the cross combination. Fruit shape is controlled by two gene and supplementary gene action is involved in the expression of the character. Whereas Similar results were reported by by Arora *et al.*, (2008), Riplda *et al.*, (2012), Patidar (2015), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Fruit colour

Parents involved in all the four crosses were differing for fruit colour character and segregation pattern obtained in these crosses are discussed here.

Cross combination 1: Poona selection × *Solanum sismblifolium*

P1 (Purple with white strips) X P2 (Green)

⇩

F_1 (Purple with white strips)

F2 segregation: 51 (Purple with white strips): 16 (Dark purple with white strips): 23 (Light purple)

Null hypothesis: the ratio of segregation of fruit colour in F2 is 9:3:4

The χ2 value (0.0.05) has been found to be lesser than the critical χ2 value at df=2. Besides the p at df=2 (0.95-.050) is greater than 0.05. Hence the null hypothesis, i.e. ratio of 9:3:4 is accepted for the trait in the cross combination. Hence it is proved that fruit colour is segregate into 9:3:4. Supplementary gene action is involved in the expression of the character. Similar results were found by Kamani J.K. (2007), Arora D. (2008),, Patidar (2015), Rego *et al.*, (1999), Scott *et al.*, (2001), Udengwu *et al.*, (2008), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Cross combination 2: Phule Harit X *Solanum Indicum*

P1 (Green with white patch) x P2 (Green)

⇩

F_1 (Green with white patch)

F2 segregation: 84 (Green with white patch): 6 (Green)

Null hypothesis: the ratio of segregation of fruit shape in F2 is 15:1

The $\chi 2$ value (0.027) has been found to be lesser than the critical $\chi 2$ value at df=1. Besides the p at df=1 (0.65) is greater than 0.05. Hence the null hypothesis, i.e. ratio of 15:1 is accepted for the trait in the cross combination. Hence it is proved that fruit colour is segregate into 15:1 ratio and duplicate dominant gene action is involved in the expression of the character. Similar results were found by Kamani J.K. (2007), Arora *et al.*, (2008), Patidar (2015), Rego *et al.*, (1999), Scott *et al.*, (2001), Udengwu *et al.*, (2008), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Cross combination 3: Poona selection X *Solanum viarum*

P1 (Purple) X P2 (Green)

⇩

F_1 (Purple with white strips)

F2 segregation: 52 (Purple with white strips): 38 (Light purple with white strips)

Null hypothesis: the ratio of segregation of fruit colour in F2 is 9:7.

The $\chi 2$ value (0.08) has been found to be lesser than the critical $\chi 2$ value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 9:7 is accepted for the trait in the cross combination. Hence it is proved that fruit colour is segregate into 9:7 ratio and complementary gene action is involved in the expression of the character. Similar results were found by Kamani (2007), Arora (2008), Patidar (2015), Rego *et al.*, (1999), Scott *et al.*, (2001), Udengwu *et al.*, (2008), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Spiny leaf

This trait is characterized by the presence or absence of spines on the stem.

Cross combination 1: Poona selection × *Solanum sismblifolium*

P_1 (Spine absent) x P_2 (Spine present)

⇩

F_1 (Spine present)

F2 segregation: 67 (Spine present): 23 (Spine absent)

Null hypothesis: the ratio of segregation of spiny and non-spiny stem in F2 is 3:1.

The $\chi 2$ value (0.014) has been found to be lesser than the critical $\chi 2$ value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. Similar results were suggested by Lachyan and Dalvi (2013), Kamani J.K. (2007), Arora D. (2008), Patidar (2015), Gopinath *et al.*, (1986), Scott *et al.*, (2001), Udengwu *et al.*, (2008), Reshmika *et al.*, (2016) and Begum *et al.*, (2017) and Nawab *et al.*, (2014).

Cross combination 2: *Phule harit x Solanum indicum*

P_1 (Spine absent) X P_2 (Spine present)

⇩

F_1 (Spine present)

F2 segregation: 66 (Spine absent): 24 (Spine present)

Null hypothesis: the ratio of segregation of spiny and non-spiny stem in F2 is 3:1.

The $\chi2$ value (0.13) has been found to be lesser than the critical $\chi2$ value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. Similar results were suggested by Kamani *et al., (*2007), Arora *et al.*, (2008), Gopinath *et al.*, (1986), Patidar (2015), Ronne *et al.*, (2012), Nawab *et al.*, (2014), Reshmika *et al., (*2016)and Begum *et al.*, (2017).

Cross combination 3: Poona selection X *Solanum viarum*

P1 (Spine absent) X P2 (Spine present)

⇩

F_1 (Spine present)

F2 segregation: 66 (Spine present): 24 (Spine absent)

Null hypothesis: the ratio of segregation of spiny and non-spiny stem in F2 is 3:1.

The $\chi2$ value (0.13) has been found to be lesser than the critical $\chi2$ value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. Similar results were suggested by Kamani *et al.*, (2007), Arora *et al.*, (2008), Gopinath *et al.*, (1986), Patidar (2015), Ronne *et al.*, (2012), Nawab *et al.*, (2014), Reshmika *et al.*, (2016)and Begum *et al.*, (2017).

Leaf spininess

This trait is characterized by the presence or absence of spines on the stem.

Cross combination 1: Poona selection × *Solanum sismblifolium*

P1 (Spine absent) X P2 (Spine present)

F_1 (Spine present)

⇩

F2 segregation: 67 (Spine present): 23 (Spine absent)

Null hypothesis: the ratio of segregation of spiny and non-spiny leaf in F2 is 3:1.

The $\chi2$ value (0.014) has been found to be lesser than the critical $\chi2$ value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. Similar results were suggested by Kamani *et al., (*2007), Arora *et al.*, (2008), Gopinath *et al.*, (1986), Patidar (2015), Ronne *et al.*, (2012), Nawab *et al.*, (2014), Reshmika *et al., (*2016)and Begum *et al.*, (2017).

Cross combination 2: Phule harit x *Solanum indicum*

P1 (Spine absent) X P2 (Spine present)
⇩
F_1 (Spine present)

F2 segregation: 68 (Spine absent): 22 (Spine present)

Null hypothesis: the ratio of segregation of spiny and non-spiny leaf in F2 is 3:1.

The χ2 value (0.014) has been found to be lesser than the critical χ2 value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted. Monogenically dominant single gene is responsible for expression of the character. Similar results were reported by Gopinath *et al.*, (1986), Kamani *et al., (*2007), Patidar (2015), Arora (2008), Reshmika *et al* (2016), Ronne R. Ripalda (2012), Begum *et al.*, (2017), Nawab *et al.*, (2014).

Cross combination 3: Poona selection x *Solanum viarum*

P1 (Spine absent) X P2 (Spine present)
⇩
F_1 (Spine present)

F2 segregation: 66 (Spine present): 24 (Spine absent)

Null hypothesis: the ratio of segregation of spiny and non-spiny leaf in F2 is 3: 1.

The χ2 value (0.13) has been found to be lesser than the critical χ2 value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. The results are in agreement with the results of Kamani *et al.*, *(*2007), Arora *et al.*, (2008), Gopinath *et al.*, (1986), Patidar (2015), Ronne *et al.*, (2012), Nawab *et al.*, (2014), Reshmika *et al.*, *(*2016)and Begum *et al.*, (2017).

Calyx spininess:

This trait is characterized by the presence or absence of spines on the calyx.

Cross combination 1: Poona selection X *Solanum sismblifolium*

P1 (Spine absent) X P2 (Spine present)
⇩
F_1 (Spine present)
F2 segregation: 66 (Spine present): 22 (Spine absent)

Null hypothesis: the ratio of segregation of spiny and non-spiny stem in F2 is 3:1.

The χ2 value (0.044) has been found to be lesser than the critical χ2 value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. Similar results were suggested by Kamani *et al.*, *(*2007), Arora *et al.*, (2008), Gopinath *et al.*, (1986), Patidar (2015), Ronne *et al.*, (2012), Nawab *et al.*, (2014), Reshmika *et al.*, (2016) and Begum *et al.*, (2017).

Cross combination 2: Phule harit X *Solanum indicum*

P1 (Spine absent) X P2 (Spine present)

F_1 (Spine present)
⇩
F2 segregation: 67 (Spine absent): 23 (Spine present)

Null hypothesis: the ratio of segregation of spiny and non-spiny calyx in F2 is 3:1.

The χ2 value (0.014) has been found to be lesser than the critical χ2 value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination. Monogenically dominant single gene is responsible for expression of the character. Similar results were suggested by Kamani *et al., (*2007), Arora *et al.,* (2008), Gopinath *et al.,* (1986), Patidar (2015), Ronne *et al.,* (2012), Nawab *et al.,* (2014), Reshmika *et al.,* (2016) and Begum *et al.,* (2017).

Cross combination 3: Poona selection X *Solanum viarum*

P1 (Spine absent) × P2 (Spine present)

F_1 (Spine present)

⇩

F2 segregation: 66 (Spine present): 22 (Spine absent)

Null hypothesis: the ratio of segregation of spiny and non-spiny calyx in F2 is 3:1.

The χ2 value (0.04) has been found to be lesser than the critical χ2 value at df=1. Besides the p at df=1 (0.95-0.50) is greater than 0.05. Hence the null hypothesis, *i.e.* ratio of 3:1 is accepted for the trait in the cross combination.

Monogenically dominant over the single gene is responsible for expression of the character. Similar results were suggested by Kamani *et al., (*2007), Arora *et al.,* (2008), Gopinath *et al.,* (1986), Patidar (2015), Ronne *et al.,* (2012), Nawab *et al.,* (2014), Reshmika *et al., (*2016)and Begum *et al.,* (2017).

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