Int.J.Curr.Microbiol.App.Sci (2017) *6*(9): 293-301

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 9 (2017) pp. 293-301**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.609.037

Effect of Growing Season on the Seed Quality Attributes of Sesamum Genotypes

C.C. Kulkarni[1], S.P. Monalisa[1*], S.K. Swain[1] and M. Behera[2]

[1]Department of Seed Science and Technology, OUAT, Bhubaneswar-751003, India
[2]Department of Plant Breeding and Genetics, OUAT, Bhubaneswar-751003, India
**Corresponding author*

A B S T R A C T

The present investigation has been planned to study the influence of growing seasons on the expression of the sowing qualities as well as nutritional qualities(moisture content, germination and field emergence percentage, vigour and storability)of seeds of all five varieties of sesame (Uma, Amrit, Nirmala, CUMS-17, Prachi). Uma was having lowest (8.41 %) and Amrit was the highest (8.56 %) percentage of moisture content and by comparing these three different seasons, the lowest was in summer season (8.03%) while the highest was in *kharif* season (9.09 %). Nirmala was having lower (81.11 %) and Prachi was the highest (82.89 %) percentage of germination**.** And the lower germination percentage was in *rabi* season (76.66 %) while the higher germination percentage was found in *kharif* season (84.40 %).Uma was having smallest (5.16 cm) and Nirmala was the highest (5.53 cm) in seedling length. The smallest seedling length was found in *rabi* season (4.97 cm) while the longest was in *kharif* season (5.80 cm).Uma, Nirmala and Prachi were having less (0.002 g) and Amrit and CUMS 17 were having highest (0.003 g) seedling dry weight. Seed vigour index-I was maximum in Nirmala (452.01) and minimum in Uma (420.91) and the lowest was found in *rabi* (381.61) while the highest was in *kharif* season (490.69).Uma, Nirmala and Prachi were having lower (0.22) and CUMS 17 was the highest (0.28) in seed vigour index-II, and highest was found in *kharif* season (0.28).

Keywords

Growing, *Kharif* season, *Rabi*, Attributes of sesamum genotypes.

Article Info

Accepted:
04 July 2017
Available Online:
10 September 2017

Introduction

India is the largest producer of oilseeds in the world and oilseed sector occupies an important position in the agricultural economy of the country. Oilseeds are among the major crops that are grown in the country apart from cereals. In terms of acreage, production and economic value, these crops are second only to food grains. India is the fifth largest vegetable oil economy in the world, next only to USA, China, Brazil and Argentina, and has an annual turnover of about Rs 80,000 crore. India accounts for 12-5 percent of oilseeds area, 7-8 percent of oilseeds production, 6-7 percent of vegetable oils production, 9-12 percent of vegetable oils import and 9-10 percent of edible oils consumption (Jha *et al.*, 2014).Sesame is one of the important oil seed crops of Odisha. Since this crop is cultivated in marginal land under rainfed condition, the production per unit area is generally very low. However, research works indicate that with the use of quality seeds of improved varieties and following the package practices, it could be

possible to obtain a yield of about 5 to 6 quintals per hectare. So there is considerable optimism that the average yield levels could early be enhanced by utilizing the quality seeds of improved varieties.In Odisha, sesame growing regions are Angul, Malkangiri, Sundargarh, Sambalpur, Dhenkanal and Bolangir. Seed is the basic unit of agriculture which gives maximum return in crop production to the farmer. Production, distribution and timely supply of quality seeds are therefore, inevitable to boost the production because no agricultural practice can improve the productivity beyond the limit set by the seed. Seed quality depends on a large number of factors such as environmental, biotic, physical and physiological. Among several factors, uniform stand establishment in the field is the main problem due to non-availability of quality seeds and consequently a reduction in yield.Seed quality plays a vital role for successful crop production in sesame as in other crops. The quality of the seed is generally estimated by its purity health and most importantly, its germination. The seed must be viable and possess physiological quality that allows rapid germination and seedling establishment. To determine the influence of growing season on the seed yield and seed quality attributes in sesame.

Materials and Methods

The present investigation has been planned to study the influence of growing seasons on the expression of the sowing qualities as well as nutritional qualities (composition) of seeds of all the varieties. The sowing quality was assessed in terms of moisture content, germination and field emergence percentage, vigour and storability of seeds.

The objective was to evaluate the seed quality attributes of sesame genotypes as influenced by different growing seasons. The details of materials used and procedure followed during the course of investigation are described below:

Experimental materials

The experimental materials for the present investigation comprised of five varieties/genotypes of sesame (Prachi, Nirmala, Uma, Amrit and CUMS 17) and the seeds were collected from AICRP on sesame, OUAT, Bhubaneswar.

Raising of seed crop

The seed crops of each treatment and replication were grown in *kharif*, *rabi* and summer, 2014-2016 using five varieties/genotypes of sesame grown, in a plot of size of 4.5x3 sq. m with spacing 30cm x 10cm.

The pods of different treatments were harvested at harvestable maturity stage and seeds after threshing were sun dried to about nine percent moisture level and stored in small cloth bags under ambient condition. The required pre and post-harvest observations were recorded in the laboratory of the department of Seed Science and Technology.

Estimation of seed moisture

The moisture content of freshly harvested seeds of each treatment of the variety and replication was estimated by air oven method (ISTA, 1985) taking duplicate samples. Approximately five gram seed sample were separately taken in empty moisture boxes and dried in an oven at 103^0 temperature for 17hours. After drying, the lids of moisture boxes were immediately covered and after cooling to room temperature, their weights recorded by help of an analytical balance. Average seed moisture content was calculated on fresh weight basis as:-

$$\text{Moisture content} = \frac{\text{Loss of moisture}}{\text{Weight of sample}} \times 100$$

Germination

Germination test was conducted by top of paper (TP) method (ISTA, 1985). Four hundred pure seeds in four replicates of 100 seeds each were arranged on moistened filter paper in petridishes and were kept in germinator at 25±^{0}C temperature for six days. On the day of final count, the numbers of normal seedlings were counted and percentage germination was computed.

Seedling length

After final germination count, ten normal seedlings from each set were kept separately for length measurement. The shoot and root portion of seedlings were separated by the help of a sharp razor and length measurement was made with the help of centimetre scale and expressed in centimetre.

The total seedling length was computed by adding these two values in respect of each variety and replication.

Seedling dry weight

The shoot and root portion of all normal seedlings after length measurement were dried in an oven at 85+^{0}C temperature for 24 hours. Then dry weight was determined by an electronic balance and was expressed in milligram.

Seed vigour index

Vigour index of seeds of all the treatments were calculated as per the formula developed by Abdul-Baki and Anderson (1973)

Seed vigour index- I = mean seedling length (cm) x germination (%)

Seed vigour index- II = mean seedling dry weight (mg) x germination (%)

Results and Discussion

The results of the investigation conducted on the influence of growing seasons on the expression of chemo-morphic traits determining plant growth, seed yield and seed quality in sesame in five varieties/genotypes of sesame have been presented in this chapter. Data pertaining to observations recorded on various plant growth, seed yield and seed quality parameters in three different growing seasons were tested statistically and the results were presented with the help of tables and figures.

Seed quality traits

Moisture content

The analysis of variance for this character showed absence of significant variation among the sesame varieties/genotypes growth in all the three seasons. In summer season, the mean values in respect of this trait among the varieties/ genotypes ranged from 7.93 % (Nirmala) to 8.12% (Prachi) with an overall mean value of 8.03% (Table 1). In *kharif* season, the mean values ranged from 8.90% (Uma) to 9.28% (CUMS 17) with an overall mean value of 9.09% (Table 1). In *rabi* season, the mean values ranged from 8.19% (Prachi) to 8.50% (Amrit) with an overall mean value of 8.32 % (Table 1).

The pooled mean values of the varieties/genotypes over three seasons showed that the sesame variety Uma was having lowest (8.41 %) and varieties Amrit was the highest (8.56 %) percentage of moisture content**.** However, comparative study of the mean values of the sesame varieties/genotypes in three different seasons indicated that the lowest content of moisture

percentage occurs in summer season (8.03 %) while the highest percentage of moisture content occurs in *kharif* season (9.09 %) (Table 2).

Germination percentage

The analysis of variance for this character showed presence of significant variation among the sesame varieties/genotypes growth in *rabi* season except *kharif* and summer seasons. In summer season, the mean values in respect of this trait among the varieties/ genotypes ranged from 82.67 % (Uma and Nirmala) to 86.67% (Amrit) with an overall mean value of 84.26% (Table 1).

In *kharif* season, the mean values ranged from 81.33% (Uma) to 86.67% (Amrit) with an overall mean value of 84.40% (Table 1). In *rabi* season, the mean values ranged from 72.0 % (Amrit) to 80.67% (Uma) with an overall mean value of 76.66 % (Table 1).

The pooled mean values of the varieties/genotypes over three seasons showed that the sesame variety Niramla was having lower (81.11 %) and variety Prachi was the highest (82.89 %) percentage of germination**.** However, comparative study of the mean values of the sesame varieties/genotypes in three different seasons indicated that the lower germination percentage occurs in *rabi* season (76.66 %) while the higher germination percentage occurs in *kharif* season (84.40 %) (Table 2).

Seedling length

The analysis of variance for this trait indicated absence of significant variation among the sesame varieties/genotypes growth in all the three seasons. In summer season, the mean values in respect of this trait among the varieties/ genotypes ranged from 5.17 cm (CUMS 17) to 5.43 cm (Amrit) with an overall mean value of 5.29 cm (Table 1). In *kharif* season, the mean values ranged from 5.37 cm (Prachi) to 6.28 cm (Nirmala) with an overall mean value of 5.80 cm (Table 1). In *rabi* season, the mean values ranged from 4.67 cm (Uma) to 5.51 cm (Prachi) with an overall mean value of 4.97 cm (Table 1).

The pooled mean values of the varieties/genotypes over three seasons showed that the sesame variety Uma was having smallest (5.16 cm) and variety Nirmala was the highest (5.53 cm) in seedling length**.** However, comparative study of the mean values of the sesame varieties/genotypes in three different seasons indicated that the smallest seedling length occurs in *rabi* season (4.97 cm) while the longest seedling length occurs in *kharif* season (5.80 cm) (Table 2).

Dry weight of seedling

The analysis of variance for this character revealed absence of significant variation among the sesame varieties/genotypes grown in two seasons except summer season. In summer season, the mean values in respect of this trait among the varieties/ genotypes ranged from 0.002 g (Uma, Nirmala and Prachi) to 0.004g (CUMS 17) with an overall mean value of 0.003 g (Table 3). In *kharif* season, the mean values were same 0.003gwith an overall mean value of 0.003g (Table 3). In *rabi* season, the mean values ranged from 0.003 g (Uma, Nirmala and Prachi) to 0.04g (Amrit and CUMS 17) with an overall mean value of 0.003g (Table 3).

The pooled mean values of the varieties/genotypes over three seasons showed that the sesame cv. Uma, cv. Nirmala and cv. Prachi were having less (0.002 g) and cv. Amrit, genotype CUMS 17 were having highest (0.003 g) weight of dry seedling. However, comparative study of the mean

values of the sesame varieties/genotypes in three different seasons indicated that seasonal influence was similar in respect of this character (Table 4).

Seed vigour index (SVI– I)

The analysis of variance for this trait indicated presence of significant variation among the sesame varieties/genotypes grown in *rabi* season and not in *kharif* and summer seasons. In summer season, the mean values in respect of this trait among the varieties/ genotypes ranged from 436.77 (Prachi) to 471.00 (Amrit) with an overall mean value of 445.96 (Table 3). In *kharif* season, the mean values ranged from 442.89 (Uma) to 534.18 (Nirmala) with an overall mean value of 490.69 (Table 3). In *rabi* season, the mean values ranged from 345.84 (Amrit) to 440.53 (Prachi) with an overall mean value of 381.61 (Table 3).

The pooled mean values of the varieties/genotypes over three seasons showed that the sesame cv. Uma was having lower (420.91) and Nirmala was the highest (452.01) in seed vigour index. However, comparative study of the mean values of the sesame varieties/genotypes in three different seasons indicated that the lowest seed vigour index- I occurs in *rabi* season (381.61) while the highest seed vigour index-I occurs in *kharif* season (490.69) (Table 4).

Table.1 Influence of growing seasons on seed moisture content (%), germination (%) and seedling length in five varieties/genotypes of sesame

Variety	Moisture Content (%)			Germination (%)			Seedling Length (cm)		
	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*
Uma	8.06	8.90	8.27	82.67	81.33	80.67	5.37	5.44	4.67
Amrit	8.03	9.17	8.50	86.67	86.67	72.00	5.43	5.88	4.80
Nirmala	7.93	9.14	8.35	82.67	84.67	76.00	5.29	6.28	5.03
CUMS 17	8.01	9.28	8.30	85.33	84.67	74.67	5.17	6.05	4.85
Prachi	8.12	8.98	8.19	84.00	84.67	80.00	5.20	5.37	5.51
Grand Mean	8.03	9.09	8.32	84.26	84.40	76.66	5.29	5.80	4.97
CD (0.05%)	NS	NS	NS	NS	NS	4.50	NS	NS	NS
CV (%)	1.542	5.560	1.164	3.81	3.55	3.30	4.52	6.77	8.09

Table.2 Influence of growing seasons on seed moisture content (%), germination (%) and seedling length in five varieties/genotypes of sesame. (Mean of three seasons)

Pooled Over Seasons			
Variety	**Moisture Content (%)**	**Germination (%)**	**Seedling Length (cm)**
Uma	8.41	81.55	5.16
Amrit	8.56	81.78	5.37
Nirmala	8.47	81.11	5.53
CUMS 17	8.53	81.55	5.35
Prachi	8.43	82.89	5.36
Grand Mean	8.48	81.77	5.35

Table.3 Influence of growing seasons on dry weight of seedling length (g), seed vigour index (SVI-I) and seed vigour index (SVI-II) in five varieties/genotypes of sesame

Variety	Dry weight of Seedling Length (g)			Seed Vigour Index (SVI)- I			SeedVigour Index (SVI)- II		
	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*	Summer	*Kharif*	*Rabi*
Uma	0.002	0.003	0.003	443.48	442.89	376.37	0.24	0.25	0.19
Amrit	0.003	0.003	0.004	471.00	409.60	345.84	0.26	0.32	0.19
Nirmala	0.002	0.003	0.003	437.89	534.18	383.96	0.23	0.28	0.18
CUMS 17	0.004	0.003	0.004	440.67	512.33	361.39	0.28	0.31	0.27
Prachi	0.002	0.003	0.003	436.77	454.49	440.53	0.22	0.25	0.19
Grand Mean	0.003	0.003	0.003	445.96	490.69	381.61	0.24	0.28	0.20
CD (0.05%)	0.001	NS	NS	NS	NS	58.79	NS	NS	0.063
CV (%)	18.114	14.816	21.679	5.28	9.43	8.66	14.95	22.83	17.38

Table.4 Influence of growing seasons on dry weight of seedling length (g), seed vigour index (SVI-I) and seed vigour index (SVI-II) in five varieties/genotypes of sesame. (Mean of three seasons)

Pooled Over Seasons			
Variety	**Dry weight of Seedling Length(g)**	**Seed Vigour Index (SVI)- I**	**SeedVigour Index (SVI)- II**
Uma	0.002	420.91	0.22
Amrit	0.003	442.14	0.25
Nirmala	0.002	452.01	0.22
CUMS 17	0.003	438.12	0.28
Prachi	0.002	443.93	0.22
Grand Mean	0.003	493.42	0.24

Seed vigour index (SVI– II)

The analysis of variance for this trait indicated absence of significant variation among the sesame varieties/genotypes growth in summer and *kharif* seasons and not in*rabi* season. In summerseason, the mean values in respect of this trait among the varieties/ genotypes ranged from 0.22 (Prachi) to 0.28 (CUMS 17) with an overall mean value of 0.24 (Table 3). In *kharif* season, the mean values ranged from 0.25 (Uma and Prachi) to 0.32 (Amrit) with an overall mean value of 0.28 (Table 3). In *rabi* season, the mean values ranged from 0.18 (Nirmala) to 0.27 (CUMS 17) with an overall mean value of 0.20 (Table 3).

The pooled mean values of the varieties/genotypes over three seasons showed that the sesame cv. Uma, cv. Nirmala and cv. Prachi were having lower (0.22) and CUMS 17 was the highest (0.28) in seed vigour index-II. However, comparative study of the mean values of the sesame varieties/genotypes in three different seasons indicated that the lower seed vigour index- II occurs in *rabi* season (0.20) while the higher seed vigour index-II occurs in *kharif* season (0.28) (Table 4).

Seed quality attributes

Seed is basically used for sowing or regeneration of crops. Maintenance of sowing quality of seed is therefore the most important consideration of any seed programme. The planting value of seed is assessed in terms of various physiological parameters viz., seed moisture content, germination and field emergence percentage, seedling growth rate, vigour and storability. Most of these traits are greatly influenced by the environmental conditions prevalent during crop growth and

post-harvest periods. Knowledge of the relationship between growing season and sowing quality of seed is considered important for production and maintenance of better quality of seed. In the present study, the sowing quality of sesame genotypes in three different seasons was assessed by seven different parameters, the results of which are discussed below.

Moisture content

Moisture content of seed is one of the crucial factor influencing seed quality during processing and storage. Maintenance of optimum seed moisture content is therefore necessary during these periods in order to maintain the seed quality at higher level. In the present study, significant genotypic variations were absent in respect of this trait in all the three seasons. In summer season, the mean values among the different varieties/genotypes ranged from 7.93 (Uma) to 8.12 percent with an overall mean value of 8.03 percent.

In *kharif* season, the mean values ranges from 8.90 (Uma) to 9.28 (CUMS 17) percent with an overall mean value of 9.09 percent. In *rabi* season the mean values ranged from 8.19 (Prachi) to 8.50 (Amrit) percent with an overall mean value of 8.32 percent. Across the seasons the var. Uma was found to possess the lowest (8.41) and var. Amrit, the highest (8.56) percent of seed moisture content.

The comparative study of the mean values of sesame varieties/genotypes in three different seasons indicated that the lowest (8.32) seed moisture content occurs in *rabi* season while the highest (9.09) percent occurs in *kharif* season. This indicated that the moisture content of seed is not influenced by genotype but the climate conditions prevalent during the maturity stage of the crop.

Germination percentage

Seed germination percentage measured under laboratory condition is the standard physiological parameter which is commonly used to assess the planting value of seed. Since germination percentage is calculated only on the basis of normal seedlings, its value accurately reflects the plant population in the field. In the present investigation, significant variations were observed among the sesame varieties/genotypes grown in *rabi* season but was absent in other two seasons. In summer season, the mean values among different genotypes ranged from 82.67% (Uma and Nirmala) to 86.67% (Amrit) with an overall mean value of 84.26%. In *kharif* season the mean values ranged from 81.33% (Uma) to 86.67% (Amrit) with an overall mean value of 84.40%. In *rabi* season mean values ranged from 72.00% (Amrit) to 80.67% (Uma) with an overall mean value of 76.66%. Across the seasons, the sesame var. Nirmala was having the lowest (81.10%) and var. Prachi, the highest (82.89%) germination percentage.

The comparative study of mean values of sesame varieties/genotypes in three different sesaons indicated that the lowest (76.66%) germination percentage occurs in *rabi* season while in *kharif* season it was the highest (84.40%).

In this case although there was absence of genotypic variations but the seasonal variation was spectacular.

Since the seeds produced in *rabi* season possessed the lowest seed weight (1000- seed weight is 2.1508g) this might be the reason for reduced germination of seeds in comparison to the seeds produced in other two seasons where the seed weight was comparatively higher. Seasonal variation in respect of this character has been reported

earlier in sorghum varieties (Deshpande *et al.*, 2002) and in hybrid bajra BJ104 (Raja Rao, 1986)

Seedling growth

The growth rate of seedlings during germination test is an indicator of seed vigour. In vigorous seeds, greater mobilization of food reserves from the storage tissue to the growing points of seedlings resulted in development of longer seedlings and higher dry weight. Therefore measurement of seedling root and shoot length and dry weight gives accurate measurement of seed vigour potential. In the present investigation, seedling growth rate was assessed in terms of both length and dry weight basis.

The results indicated that absence of significant variation among sesame varities/genotypes grown in all the three seasons. In summer season, the mean values among the different sesame varieties/genotypes ranged from 5.17cm (Uma) to 5.43cm (Prachi) with an overall mean value of 5.29cm. In *kharif* season the mean values ranged from 5.37cm (Prachi) to 6.28cm (Nirmala) with an overall mean value of 5.80cm. In *rabi* season the mean values ranged from 4.67cm (CUMS 17) to 5.51cm (Amrit) with an overall mean value of 4.97cm. Across the seasons the sesame var. Uma possessed the smallest (5.16cm) and var. Nirmala, the highest (5.53cm) seedling length.

The comparative study of the mean values of different varieties in three different seasons indicated that the smallest (4.97cm) and longest (5.80cm) seedlings occur in *rabi* and *kharif* seasons respectively. The smaller seed size in *rabi* season might be the reason for reduced growth of seedlings. Seasonal variation in respect of this character has been reported earlier in sorghum varieties (Deshpande *et al.*, 2002) and in hybrid bajra BJ104 (Raja Rao, 1986).

Dry weight of seedling

The results indicated absence of significant genotypic variation in two seasons except summer season. In summer season, the mean values among different varieties/genotypes ranged from 0.002g (Uma, Nirmala and Prachi) to 0.004g (CUMS 17) with an overall mean value of 0.003g. In *kharif* season, all the varieties possessed the same (0.003g) seedling dry weight. In *rabi* season mean values ranged from 0.003g (Uma, Nirmala and Prachi) to 0.004g (Amrit and CUMS 17) with an overall mean value of 0.003g. Across the seasons the sesame var. Uma, Nirmala and Prachi possessed the lowest (0.002g) and sesame varieties/genotypes Amrit and CUMS 17, the highest (0.003g) seedling dry weight. The comparative study of mean values of sesame varieties/genotypes in three different seasons indicated that seasonal influence was similar in respect of this character. Seasonal variation in respect of this character has been reported earlier in sorghum varieties (Deshpande *et al.*, 2002) and in hybrid bajra BJ104 (Raja Rao, 1986).

Seed vigour

Stand establishment potential of seed lot is predicted more precisely basing on seed vigour than on the basis of laboratory germination percentage. The performance of crop was also highly depends on seed vigour. Therefore in studies involving the seed production, due emphasis is given on determination of seed vigour. The common parameters used to represent seed vigour is the seed vigour index (SVI-I) which is measured by integrating two other physiological quality parameters viz., germination percentage and seedling length or

seedling dry weight. In the present study, significant genotypic variations were absent in respect of both the vigour parameters (SVI-I &II) except *rabi* season. In summer season, the mean values among the different sesame varieties/genotypes ranged from 436.77 (Prachi) to 471.00 (Amrit) with an overall mean value of 445.96. In *kharif* season, mean values ranged from 442.89 (Uma) to 537.18 (Nirmala) with an overall mean value of 490.69.

In *rabi* season the mean values ranged from 345.84 (Amrit) to 440.53 (Prachi) with an overall mean value of 381.61. Across the seasons sesame var. Uma possessed the lowest (420.91) and var. Nirmala, the highest (452.01) SVI-I. The comparative study of the mean values in three different seasons indicated that the lowest (381.61) and highest (490.69) SVI-I values occurs in *rabi* and *kharif* seasons respectively.

The seed vigour measured on seedling dry weight basis (SVI-II) also showed the similar trend of variation among the genotypes as well as growing seasons. Seasonal variation in respect of this character has been reported earlier in sorghum varieties (Deshpande *et al.*, 2002) and in hybrid bajra BJ104 (Raja Rao, 1986).

References

Abdul Baki, A.A., and Anderson, J.D. 1973. Vigour determination in soybean by multiple criteria. *Crop Sci.*, 13: 630-633

Deshpande, C.A., Shekhargouda, M., Shashidhara, S.D and Ravikumar, R.L. 2002. Effect of growing seasons on performance of parental lines and varieties of sorghum (*Sorghum bicolor* L. Moench).*Seed Tech News*, 32(1):57-58

ISTA, 1985. International Rules for Seed Testing. Seed Science and Technology 13:229-255

Jha, G.K., Pal, S., Mathur, V.C., Bisaria, G and Dubey, S.K. 2014. Edible oilseed supply and demands scenario in India: Implication for policy, Division of Agricultural Economics, IARI, New Delhi.

Raja Rao, M.K., and Kulkarni, G.N. 1986. Evolution of planting ratios of parental lines for BJ104 hybrid Perlmillet production. *Seed Res*. 14(2): 241-243.

How to cite this article:

Kulkarni, C.C., S.P. Monalisa, S.K. Swain and Behera, M. 2017. Effect of Growing Season on the Seed Quality Attributes of Sesamum Genotypes. *Int.J.Curr.Microbiol.App.Sci.* 6(9): 293-301. doi: https://doi.org/10.20546/ijcmas.2017.609.037