Int.J.Curr.Microbiol.App.Sci (2018) Special Issue-6: 120-127

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-6 pp. 120-127**
Journal homepage: http://www.ijcmas.com

Original Research Article

Estimation of Variability in Mutant 296B Genotype of Sorghum (*Sorghum bicolor* L.) in M_2 Generation

J.D. Deshmukh*, V.S. Pawar and H.V. Kalpande

Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, MH-431402, India
**Corresponding author*

A B S T R A C T

The present study carried out at Sorghum Research Station, Parbhani during *Kharif 2016*.Entitled "Studies on genetic variability induced through mutation in M_2 generation of *Kharif* sorghum (*Sorghum bicolor* L.)". Different doses of gamma rays (10kR, 20kR, 30kR, 40kR and 50kR) were used to irradiate seeds of 296B genotype. Genetic variability was significant for yield and yield contributing characters among the M_2 generation. Results indicated relatively higher mean performance in treatment 50kR dose for most of the characters. Genetic variability was significant for yield and yield contributing characters among the M_2 generation. Results indicated relatively higher mean performance in treatment 50kR dose for most of the characters. The GCV and PCV estimates showed wide variation for most of the characters in segregating M_2 generation. High GCV, PCV, heritability and GAM were observed for grain yield per plant.

Keywords

Sorghum, Variability, heritability

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is an important staple food for more than 300 million people and feed for cattle in Asia and Africa. It is the fourth most important cereal crop followed by rice, wheat and maize. India is a major sorghum growing country in the world, ranks first in acreage and second in production next to United States of America. In India sorghum is grown in areas receiving 500 to 1000 mm annual rainfall with temperature ranging between 26 to 32^{o}C. Plain and plateau below 1000 m elevation offer an excellent scope for successful cultivation of the crop in two seasons viz., *'Kharif '* as rainfed crop and '*Rabi'* with protective irrigation constituting 60 and 40 per cent cultivation respectively. (Anand *et al.*, 2014).

Genetic variability for economic traits is the pre-requisite for any successful breeding programmers as the degree of response to selection depends on the quantum of variability. In any crop, yield being a complex character influenced by many of its contributing characters controlled by polygene and the environmental factors.

So, an understanding of genetics of yield and its component traits, association between each component trait and yield is necessary for planning effective selection procedure in developing high yielding genotypes. However, the inheritance of quantitative traits is often influenced by variation in other character which may be due to pleiotropy or genetic linkage.

Materials and Methods

The present investigation on "Studies on genetic variability induced through mutation in M_2 generation of *Kharif* sorghum (*Sorghum bicolor* L.)" was undertaken in sorghum (*Sorghum bicolor* L.) at research farm of Sorghum Research Station, Parbhani. Uniform 200 pure dry seeds with about 10 ± 1 per cent moisture of one *kharif* sorghum variety 296B were exposed to 10, 20, 30, 40 and 50kR dose of gamma rays (Co^{60}) with a dose rate of 2.39kR per minute at Nuclear and Agriculture Division, BARC, Trombay, Mumbai and the same number of untreated seeds of each variety served as control. For M_2 generation seeds selected from M_1 generation that treated with physical mutagen. The observations were recorded on following sixteen characters.

Initial plant count, Mortality (%), Days to panicle initiation, Days to 50% flowering, Days to maturity, Field grain mold score, Threshed grain mold score, Plant height (cm), Flag leaf area (cm^2), Panicle length (cm), Number of primaries/panicle, Number of grains/Primary, 100 seed weight (g), Fodder yield/Plant (g), Harvest index (%) and Grain yield/Plant (g).

Results and Discussion

The results of analysis of variance for M_2 generation of *Kharif* sorghum are furnished in Table 1. Highly significant differences among the genotypes were observed for sixteen characters indicating presence of sufficient amount of variability among genotypes for these sixteen characters. Variation for yield and some yield contributing character was also reported earlier by Khairhayat *et al.,* (1990), Kenga *et al.,* (2005), Larik *et al.,* (2009), Jayaramachandran *et al.,* (2010), Puspitasari *et al.,* (2012), Khaingwahhtun *et al.,* (2015).

The genetic components *viz.,* genotypic variance, phenotypic variance, genotypic co-efficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (broad sense), genetic advance (GA) and genetic advance as the per cent of mean were worked out using appropriate statistical formulae for all sixteen characters in M_2 generation of *Kharif* sorghum. The results are presented in Table 2 and Figure 1. The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) in relation with each character

The observed values of genotypic variance and phenotypic variance values were observed 348.80 and 378.03, respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 6.36 per cent and 6.63 percent, respectively. This character exhibited high broad sense heritability (92.27%) coupled with genetic advance as the percent of mean 12.59.The character under study exhibited genotypic variance and phenotypic variance values were 203.51 and 205.10, respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 93.54 percent and 93.90 per cent, respectively. High heritability (99.22%) coupled with genetic advance as the percent of mean 191.93.

The genotypic variance (11.98) and phenotypic variance (17.01) was recorded for this character. The genotypic coefficient of variation (GCV) was 5.28 percent and phenotypic coefficient of variation (PCV) was 6.30 per cent. High heritability (70.43%) and low genetic advance as percent of mean (9.13) was observed for the trait days to panicle initiation. Plant height showed genotypic variance and phenotypic variance recorded as 555.44 and 626.81,

respectively. The genotypic coefficient of variation (GCV) was 15.73 percent and phenotypic coefficient of variation (PCV) was 16.71 percent. High heritability (88.61%), high genetic advance as percent of mean (30.50) were observed.

The character under study exhibited genotypic variance (10.07) and phenotypic variance (11.71). The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 4.24 percent and 4.58 per cent, respectively. High heritability estimates (86.04) coupled with genetic advance as the percent of mean 8.10 was noticed for this character. The genotypic variance (1457.22) and phenotypic variance (1872.39) was noticed in flag leaf area. The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 12.83 percent and 14.55 percent, respectively. This character exhibited high heritability (77.83%) coupled with high genetic advance as the percent of mean 23.32.The genotypic variance and phenotypic variance values for days to maturity found as 25.30 and 34.95, respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 4.26 percent and 5.01 percent, respectively. High heritability estimates (72.39%) coupled with low genetic advance as per cent of mean 7.47 was noticed.

The character under study exhibited genotypic variance (28.92) and phenotypic variance (34.83). The estimated genotypic coefficient of variation (GCV) (8.46%) and phenotypic coefficient of variation (PCV) (9.29 %) recorded for this trait. This character exhibited high heritability (83.02%) coupled with moderate genetic advance as the percent of mean 15.88.Number of grains per primary showed genotypic variance and phenotypic variance recorded as 49.55 and 52.29,respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 18.66 percent and 19.17 per cent, respectively. This character exhibited high heritability (94.76%) coupled with high genetic advance as the percent of mean 37.41 was observed for this character.

The genotypic variance and phenotypic variance values for number of grains per primary recorded as 23.69 and 26.51 respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 15.38 percent and 16.27 percent, respectively. This character exhibited high heritability (89.37%) coupled with high genetic advance as the percent of mean 29.94 was observed for this character. The genotypic variance and phenotypic variance values for number of grain per primary found as 1.79 and 2.34 respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 19.95 percent and 22.83 percent, respectively. This character exhibited high heritability (76.35%) coupled with high genetic advance as the percent of mean 35.90 was noticed for this character. The character under study exhibited genotypic variance (2.08) and phenotypic variance (2.57). The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 24.47 percent and 27.16 percent, respectively. This character exhibit the high heritability (81.17%) coupled with high genetic advance as the per cent of mean 45.41 was exhibited for this character.It is worthwhile to note that high GCV and PCV were exhibited for mortality, field grain mold score, harvest index and

grain yield per plant in all irradiated M_2 progenies of 296B genotype, While, highest PCV exhibited for threshed grain mold score which is in conformity with the findings of Kim (1977), ShobhaLaxani (2008) in wheat, Ran *et al.,* (2010) in blackgram and Unche *et al.,* (2008), Arunkumar *et al.,* (2004), Veerabadhiran *et al.,* (2001) and Biradar *et al.,* (1996) in sorghum. Khaing Wah Htun *et al.,* (2015) reported 300 Gy exhibited highest GCV and PCV for grain yield per plant.

The estimates of genotypic and phenotypic variance were lowest among all the characters under study. The genotypic variance and phenotypic variance values for number of grain per primary found as 0.11 and 0.12, respectively. The estimated genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for this trait were 14.01 percent and 14.49 percent, respectively. This character exhibited a high heritability (93.53%) coupled with high genetic advance as the percent of mean 27.91 was recorded for this character. The variance components genotypic and phenotypic variance was 107.07 and 113.51, respectively. The variability components GCV and PCV had 20.48 percent and 21.08 percent values. High heritability (94.33%) along with high genetic advance percent of mean was 40.96 was noticed for this character. The character under study exhibited genotypic variance (1630.93) and phenotypic variance (2046.57). The variability components GCV (13.41) and PCV (15.02) were recorded for this character. High heritability (79.69%) along with high genetic advance as the percent of mean 24.65 was recorded for this character.

The variance components genotypic and phenotypic variances were 43.21 and 44.91, respectively. The variability components GCV and PCV had 38.80 percent and 39.55 percent values. High heritability of (96.22%) along with high genetic advance as percent of mean was 78.39 observed for this character.Yield being a complex character which is influenced by many factors. In the present study, high heritability coupled with high genetic advance as per cent over mean was observed for mortality, plant height, flag leaf area, fodder yield per plant, number of seeds per primary, panicle length, threshed grain mold score, filed grain mold score, 100 seed weight, grain yield per plant and harvest index in irradiated M_2 progenies of 296B genotypes. Therefore, high heritability accompanied with high genetic advance indicates predominance of additive gene action in such cases selection may be effective.

Similar results have also been reported by Veerabadhiran *et al.,* (2001), Unche *et al.,* (2008) in sorghum. Dora and Kamala (1986), Ganeshan (2005) for 100 seed weight. Nguyen *et al.,* (1998) and Veerabadhiran and Kennedy (2001) for 100 seed weight. Anand and Kajidoni (2014) for grain yield.

Nang Htwe Kham *et al.,* (2015) reported for plant height and seed yield per plant. Biradar *et al.,* (1996) noticed for plant height, panicle length and grain yield. Nguyen *et al.,* (1998) for plant height. Deepalakshmi *et al.,* (2007) for grain mold score, plant height, panicle length, seed yield per plant and 100 seed weight.

High heritability with moderate genetic advance as per cent over mean for was recorded for initial plant count and number of primaries per panicle in all irradiated M_2 progenies. The reports of Biradar *et al.,* (1996) noticed high heritability coupled with high genetic advance as per cent over the mean for number of primaries per panicle.

Table.1 Analysis of variance for various characters in sorghum

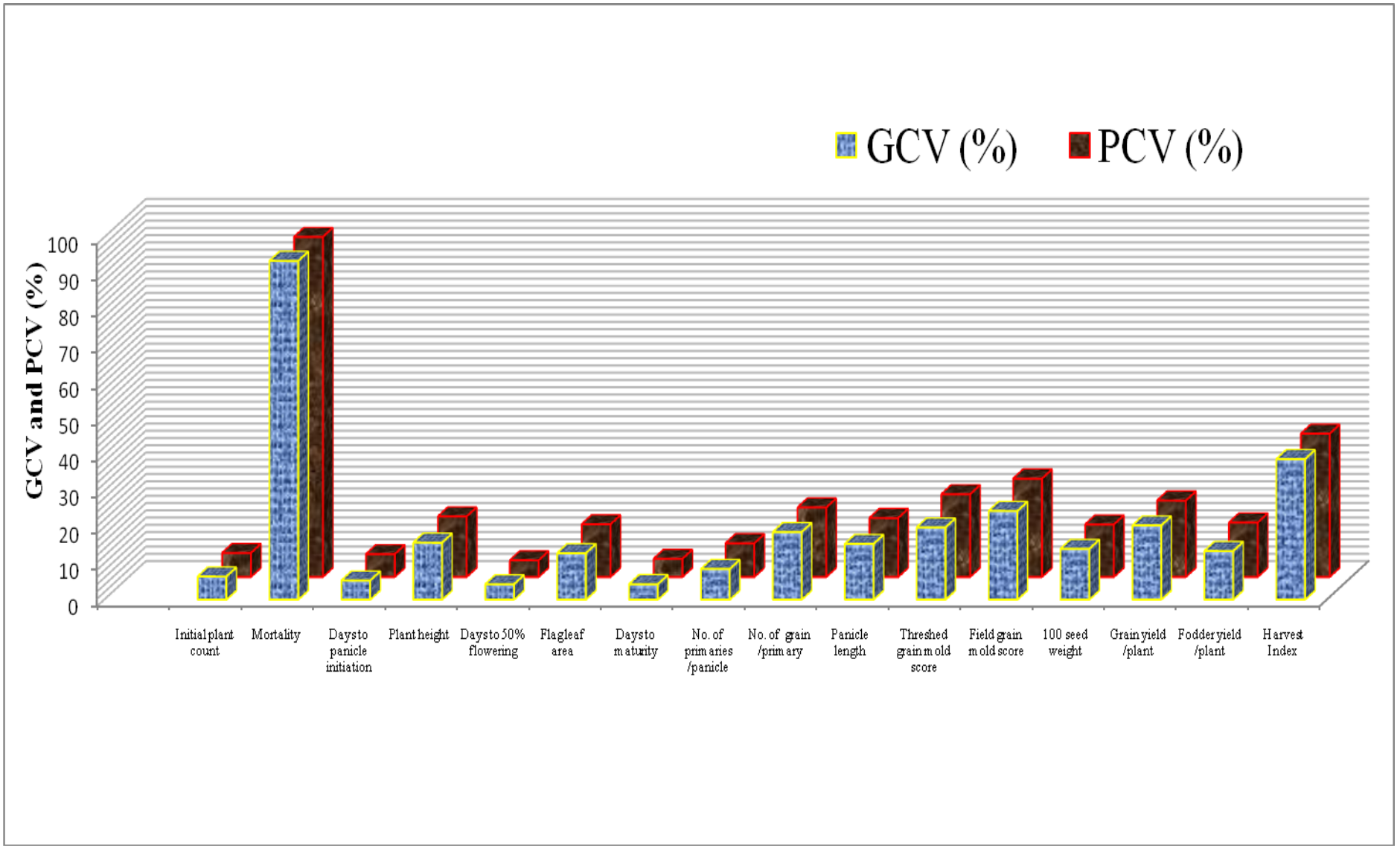
Sources of variation	D.F.	Mean sum of squares							
		Initial plant count	Mortality (%)	Days to panicle initiation	Plant height (cm)	Days to 50% flowering	Flag leaf area (cm^2)	Days to maturity	No. of primaries//panicle
Replication	2	1.333	1.041	26.476	79.822	3.190	1145.013	4.428	12.229
Treatments	6	1075.651**	612.139**	40.984**	1737.71**	31.873**	4786.838**	85.555**	92.682**
Error	12	29.22	1.590	5.031	71.373	1.634	415.176	9.650	5.914

Sources of variation	D.F.	Mean sum of squares							
		No. of grain /primary	Panicle length (cm)	Threshed grain mold score	Field grain mold score	100 seed weight	Grain yield /plant	Fodder yield /plant	Harvest Index (%)
Replication	2	4.476	8.531	1	0.761	0.0014	31.675	41.555	1.891
Treatments	6	151.401**	73.900**	5.936**	6.746**	0.349**	327.678**	5308.439*	131.337**
Error	12	2.737	2.818	0.555	0.484	0.007	6.440	415.644	1.698

Table.2 Genetic variability parameters for yield and yield contributing characters in M_2 generation of *Kharif* sorghum

Sr. No.	Characters	Range		Mean	σ^2 (g) (Genotypic variance)	σ^2 (p) (Phenotypic variance)	GCV (%)	PCV (%)	h^2 b.s.(%)	GA	GA as % of mean
		Minimum	Maximum								
1	Initial plant count	268	312.66	293.47	348.80	378.03	6.36	6.63	92.27	36.95	12.59
2	Mortality (%)	0.00	35.00	15.25	203.51	205.10	93.54	93.90	99.22	29.27	191.93
3	Days to panicle initiation	61.00	70.33	65.52	11.98	17.01	5.28	6.30	70.43	5.98	9.13
4	Plant height (cm)	115.2	173.8	149.8	555.44	626.81	15.73	16.71	88.61	45.70	30.50
5	Days to 50% flowering	70.33	78.66	74.80	10.07	11.71	4.24	4.58	86.04	6.06	8.10
6	Flag leaf area (cm^2)	220.2	336.1	297.4	1457.22	1872.39	12.83	14.55	77.83	69.37	23.32
7	Days to maturity	110.66	124.33	118.00	25.30	34.95	4.26	5.01	72.39	8.81	7.47
8	No. of primaries /panicle	55.63	71.36	63.53	28.92	34.83	8.46	9.29	83.02	10.09	15.88
9	No. of grains /primary	29.00	47.91	37.72	49.55	52.29	18.66	19.17	94.76	14.11	37.41
10	Panicle length (cm)	24.24	35.78	31.65	23.69	26.51	15.38	16.27	89.37	9.47	29.94
11	Threshed grain mold score	4.66	8.00	6.71	1.79	2.34	19.95	22.83	76.35	2.41	35.90
12	Field grain mold score	4.00	7.66	5.90	2.08	2.57	24.47	27.16	81.17	2.68	45.41
13	100 seed weight (g)	1.93	2.88	2.40	0.11	0.12	14.01	14.49	93.53	0.67	27.91
14	Grain yield /plant (g)	34.53	62.16	50.53	107.07	113.51	20.48	21.08	94.33	20.70	40.96
15	Fodder yield /plant (g)	251.86	351.46	301.20	1630.93	2046.57	13.41	15.02	79.69	74.265	24.656
16	Harvest Index (%)	11.12	26.56	16.94	43.21	44.91	38.80	39.55	96.22	13.283	78.393

Fig.1 GCV and PCV for yield and yield contributing characters in M_2 generation of *Kharif* sorghum



Deepalakshmi *et al.,* (2007) noticed high heritability with high genetic advance as per cent over mean for number of primaries per panicle. The High heritability with low genetic advance as per cent over mean for days to panicle initiation, days to 50 per cent flowering and days to maturity was recorded for in all irradiated M_2 progenies. Veerabadhiran and Kennedy (2001) indicated high heritability with high genetic advance as per cent over mean for days to 50 flowering. Deepalakshmi *et al.,* (2007) noticed high heritability with high genetic advance as per cent over mean for days to 50 flowering and 100 seed weight.

References

Anand, Y. and S.T. Kajidoni. (2014) Genetic enhancement of grain size and other productivity related traits through induced variability in kharif sorghum. *Karnataka Jr. Agric. Sci.*, 27(2):121-124.

Arunkumar, B., B.D.Biradar and P. M. Salimath. (2004) Genetic variability and character association studies in *rabi*sorghum. *Kar. J. Agri. Sci.,* 17 (3): 471-475.

Biradar, B.D., R.Parameshwarappa, Patil, S.S. and P. Parameshwargoud. (1996) Inheritance of seed size in sorghum *(Sorghum bicolor* L. Moench). *Crop Res.,* 11(3): 331-337.

Borikar, S. T. and N. L.Bhale. (1982) Line x Tester analysis for yield components in winter sorghum. *Sorghum Newslett.,* 25: 18.

Deepalakshmi, A.J. and K.Ganesamurthy. (2007) Studies on genetic variability and Character association in *kharif* sorghum [*Sorghum bicolor* (L.) Moench]. *Indian J. Agricultural Research.* 41(3): 177-182.

Dora, K.B. and T.Kamala. (1986) Gingelly (*Sesamum indicum* L.) lines resistant to phyllody and stem rot. *J. Indian Bot. Soc.,* 66: 297-300.

Ganeshan, K.N. (20050 Variability studies in determinate type sesame, *Sesamum indicum* L.

Jayaramachandran, M., N. Kumararadival, S. Eapen and K. Kandasamy. 2010. Gene action for yield attributing characters in segregating generation (M_2) of sorghum. *Electron. J. Pl. Breed.,* 1(4): 802-805.

KhaingWahHtun, Myat Min, Nay Chi Win. (2015) Evaluation of genetic variability for agronomic traits in M_2 generation of Sorghum through induced Mutation. *Int. J. Technical Research and Applications*, 3(6):145-149.

KhaingWahHtun, Nay Chi Win, My At Minn. (2015) The improvement of Sorghum (*Sorghum bicolor* L.) for high yield through induced mutation. 5th International Conference, Bongkok, Thailand.

Kim, Y.S. (1977) Studies on the technique of inducing mutation in cereals. *Korean J. Breed. York Jong HakJoiJi,* 9: 83-117.

Laric, A.S., S. Memon and Z.A. Soomro. (2009) Radiation induced polygenic mutation sorghum bicolor L. *J. Agric. Res.,* 47(1): 11-19.

Nang Htwe Kham, Nay Chi Win, Myat Minn. (2015) Study on the variability of induced mutation for improvement of local cultivar sorghum (shweni-15) International Journal of Technical Research and Applications. 3(6): 139-144.

Nguyen Duy Can, T.A.D. Haryano and Yoshida. (1998) Genetic variability and characteristic association analysis in grain sorghum, *J. Fac. Agric. Kyu.* Univ., 43 (1/2): 25-30.

Puspitasari W., S. Human, D.Wirnas and Trikoesoemaningtyas. (2012)

Evaluating genetic variability of sorghum mutant lines tolerant to acid soil. Atom Indonesia, 38(2): 83-88.

Puspitasari, W.S., D. Human, Wirnas and Trikoesoemaningtyas. (2012) Evaluating genetic variability of sorghum mutant lines tolerant to acid soil. *Atom Indonesia,* 38 (2): 83-88.

Rana, B.S., J. Rao and N.G.P. Rao. (1978) Genetic analysis of some Exotic x Indian, crosses in sorghum XVIII. Breeding for resistance to grain deterioration. *Indian J. Genet. Plant Breed.,* 38: 322-332.

Sheeba, A., S.M. Ibrahim, P. Yogameenakshi and S. Babu. (2003) Effect of mutagenes on uantitative traits in M_2 generation in sesame (*Sesamum indicum* L.). *Indian J. Genet.,* 63(2): 173-174.

Unche, P.B., M.B. Misal, S.B. Borgaonkar, G.V. Godhawale, B.D. Chavan, D.R. Sawant. (2008) Genetic variability studies in sweet sorghum (*Sorghum bicolor* L. Moench). *Int. J. PlantSci.* 3(1): 16-18.

Veerabadhiran, P. and V.J.F. Kennedy. (2001) Correlation and path analysis studies in selected germplasms of sorghum. *Madras Agric. J.,* 88(4/6): 309-310.