The Bioscan 8(4): 1357-1361, 2013 (Supplement on Genetics & Plant Breeding)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

VARIABILITY STUDIES IN M_3 GENERATION IN BLACKGRAM (*VIGNA MUNGO* (L.)HEPPER)

M. P. MESHRAM*, R. I. ALI, A. N. PATIL AND SUNITA MEENA
Pulses Research unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Krishi Nagar, Akola, Maharashtra - 444 001
e-mail: mpmeshram358@gmail.com

KEYWORDS
Vigna mungo
Genetic variability
yield components.

Received on :
24.09.2013

Accepted on :
07.11.2013

***Corresponding author**

ABSTRACT
In the present study, pure line seeds of black gram variety viz. T-9, TPU-4 and one promising genotype AKU-18 was treated with gamma irradiation (15kR, 25kR and 35kR) with the objective to assess the variability in M_3 generation.. Highest GCV and PCV and high estimates of heritability were recorded for the characters sprouting percentage, number of pods plant^{-1} and grain yield plant^{-1} (g). High heritability accompanied with high genetic advance was recorded for number of pods plant^{-1} governed by additive gene effects and therefore selection based on phenotypic performance will be useful to improve character in future.

INTRODUCTION

Black gram (*Vigna mungo* L. Hepper), popularly known as urdbean, urid or mash is an important self-pollinating diploid grain legume and belongs to the family Leguminosae and subfamily Papilionaceae. It is an important food legume crop of the Indian subcontinent, it is rich protein content. And is widely cultivated grain legume in the Indian sub-continent, comprising of India, Burma, Bangladesh, and Sri Lanka (Nag *et al.,* 2006). Black gram is considered to have been domesticated in India from its wild ancestral form *V.mungo* var.*silvestris* (Lukoki *et al.,*1980). Center of genetic diversity is found in India (Zeven *et al.,* 1982). The chromosome number of this crop is 2n = 2x = 22.

The productivity of pulses is very low as compared to cereals, which have been selected for high grain yield under high input conditions, while the selection pressure in case of pulses have been focused on the adaptation to both biotic and abiotic stresses

Selection of genotypes based on yield as such is difficult to the integrated structure of plant in which most of the characters are inherited and being governed by the large number of cumulative, duplicate and dominant genes. Urdbean breeding strategy involves generating genetic material, selection of superior genotypes from the variable genetic material to develop superior varieties.

Induced mutations was used to generate genetic variability and have been successfully utilized to improve yield and yield components of various pulse crops like *Vigna unguiculata* (Mensah and Akomeah,1992), *Cajanus cajan* (Srivastava and Singh, 1996) and *Vigna mungo* (Kundu and Singh, 1981). This show that mutagenesis is a tool to be employed for crop improvement.

In the present study, therefore, an attempt was made to partition the variance components, especially phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), broad-sense heritability (h^2) and genetic advance (GA) for yield and yield components in M_3 generations of Urdbean.

MATERIALS AND METHODS

The present investigation was conducted at the field of Pulses Research Unit, Dr. PDKV, Akola and Maharashtra during *kharif* 2011 with two cultivated released varieties and one promising genotype of blackgram viz., T-9, TPU-4, and AKU-18 respectively. Eighty gram seeds of each variety irradiated with 15kR, 25kR, 35kR gamma rays at the BARC (Bhabha Atomic Research Centre) Trombay, Mumbai on 27th Feb, 2010.
In *kharif* 2011 all the harvested plant seeds from each treatment from M_2 generation was sown to raise M_3 generation in replicated trial using Randomized Blocks Design and the observations on Germination percentage, Days to 50% flowering, Plant height (cm), No. of branches plant^{-1}, No. of pods plant^{-1}, Pod length (cm), No. of seeds plant^{-1}, Grain yield plant^{-1} (g), Days to maturity, Final plant count and Sprouting percentage were recorded. The data available on individual characters was subjected to the method of analysis of variance commonly applicable to the Randomized Blocks Design (Panse and Sukhatme, 1954). Parameters estimated were the phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), broad-sense heritability (h^2) and expected genetic advance (GA). All were estimated in the standard manner, expect genetic advance. The estimate of the genetic advance (GA, expressed as a percentage of the mean value)

with an assumed 1% selection intensity was computed by the formula of Allard (1960):

$GA = k.\ óp.\ h^2$

Where,

h^2 = broad-sense heritability

óp = Phenotypic standard deviation of the mean performance of the treated population

k = 2.64, constant for 1% selection intensity (*i.e.* the highest-performing 1% are selected)

RESULTS AND DISCUSSION

The treated seeds along with one control for each genotype were sown to raise M_1 generation in replicated trial during *Summer* 2010 at the research field of Department of Agril. Botany, Dr.PDKV, Akola. The M_1 generation was observed for different parameters besides population screened for chlorophyll mutants. Seeds from each plant of M_1 generation were harvested separately.

The M_2 generation was raised in *kharif* 2010 plant to row progenies were raised from all the harvested seeds from each treatment. The treated populations were carefully screened for desirable economic viable mutants. 220 selected mutant plants and treatment wise randomly selected plants harvested for confirmation of mutants and variability study in M_3 generation.

In *kharif* 2011, all the harvested plant seeds from each treatment from M_2 generation were sown to raise M_3 generation in replicated trial using Randomized Blocks Design. The sowing was undertaken on the well leveled piece of land at the field of Pulses Research Unit, Dr.PDKV, Akola. In M_3 generation the desired mutants obtained were AKU-18 (61 days) and T9 (52 days) with respective doses of 35 and 25 kR showed early maturity than control (71 days). The lower dose 15 kR in TPU-4 (7cm) found more effective than the other doses for long pod character which shows 2 cm long pod than control whereas for the bold seed character, AKU-18 (5.3g/100 seed) and T9 (5.2g/100 seed) depicted more test weight than control 4.2g and 3.8 g /100 seeds respectively with doses of 35 and 25 kR. The dose 25 kR in AKU-18 shows 120 percent more number of pods than control.

The treatment mean sum of squares was found to be significant for various yields and yield contributing characters under study. This indicates the presence of substantial amount of variability among the genotypes for all the characters. Considerable variation among the genotype of black gram has also been reported by. Singh *et al.* (2000) and Sharma *et al* (2008) in gamma rays irradiated populations (Table 1).

The estimate of genotypic (29.40) and phenotypic (32.04) variances were found to be highest for number of pods plant^{-1}. The character 100 seed weight had lowest phenotypic (0.14) and genotypic (0.09) variance. The low magnitude of genetic variability for 100 seed weight might be due to greater influence of environmental factor which resulted in the enhanced phenotypic variability. Similar results were reported by Verma and Singh (1984) for days to maturity, plant height, pods plant^{-1} and 100 seed weight in greengram. (Table2).

The mean of all treatments for germination percentage was 88.22%. In genotype T-9, 15kR gamma rays (V1T1) dose found more effective for the characters viz., as germination percentage, number of pods plant^{-1}, grain yield plant^{-1}, 100 seed weight compare to control and 25kR gamma rays (V1T2) is also more effective for the characters pod length, number of pods plant^{-1}, grain yield plant^{-1}, as compare to control hence for improvement of this genotypes 15 kR and 25 kR gamma rays doses will be helpful for further improvement. Similar results were obtained by Verma and Singh (1984) in irradiated green gram with gamma rays at doses of 20kR, 30kR, 40kR and 50kR. They recorded increased means for days to maturity, plant height, pod per cluster and 100 seed weight at all the doses except at 50kR for days to maturity, Waghmare and Mehra (2000) also reported significant increase in induced variability for grain yield plant^{-1} followed by number of pods plant^{-1}, number of seed per pod and plant height in grasspea. Singh *et al.* (2000) in blackgram studied gamma rays and EMS induced genetic variability for quantitative traits in urdbean cv, T-9 and PDU-1 and found that mutagenic treatment had wider values than control.

In the genotype TPU-4 15kR gamma rays dose (V2T1) found more effective for the characters, viz., germination percentage, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds per pod, grain yield plant^{-1}, compare to control and 25kR gamma dose (V2T2) also found more effective for the characters like germination percentage, number of pods plant^{-1}, number of seeds pod^{-1} and sprouting percentage, hence

Table 1: Analysis of variance for various yield and yield contributing characters in M_3 generation

Source	D.F.	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches per plant	Pod length (cm)	No. of pods per plant	No. of seeds per pod	Grain yield per plant (g)	100 seed weight (g)	Sprouting percentage
Replications	2	1.86	2.77	7.16	0.06	0.22	7.62	0.08	0.00	0.07	0.46
Treatments	11	3.36**	19.36**	39.01**	1.80**	0.14**	2.63**	0.04**	0.16**	0.34**	0.92**
Error	22	0.92	4.53	10.43	0.27	0.66	90.86	3.07	2.70	0.04	58.87

Table 2: Genotypic (Vp), phenotypic (Vp), and environmental (Ve) variance components for various yield and yield contributing characters in M_3 generation

S. no.	Characters	Vg	Vp	Ve
1	Days to 50% flowering	0.81	1.73	0.92
2	Days to maturity	4.94	9.47	4.53
3	Plant height (cm)	9.52	19.95	10.43
4	Number of branches per plant	0.50	0.78	0.27
5	Pod length (cm)	0.17	0.31	0.14
6	Number of pods per plant	29.40	32.04	2.63
7	Number of seeds per pod	1.00	1.05	0.04
8	Grain yield per plant (g.)	0.84	1.00	0.16
9	100 seed weight (g.)	0.09	0.14	0.04
10	Sprouting percentage	19.31	20.24	0.92

improvement of this genotypes in the population, both 15 kR and 25 kR gamma rays doses will be helpful. The results of present investigation were also in conformity with the result of Conger *et al*. (1976), reported increased variability for pods plant^{-1}, 100 seed weight and total seed weight plant^{-1} in M_3 generation in soybean. Khan (1983) also reported increased mean value and range of variation for the characters pod length, seed yield plant^{-1}, 100seed weight and total seed yield in M_3 generation of *Vigna radiata*.

In genotype AKU-18 with 35kR gamma rays dose (V3T3) found more effective for the significantly superior for the characters like germination percentage, number of branches plant^{-1} and grain yield plant^{-1} as compare to control. Hence for improvement of these characters 35 kR gamma dose will be helpful. These results are agreement with those of Singh *et al*. (1979), Sharma *et al*. (2008) in black gram. They observed significant change in wide range of variation for the characters, number of branches plant^{-1} and grain yield plant^{-1} at 20 kR and 30 kR gamma rays dose in T-9, Pant U -19 and Pant Urd-30 cultivars. (Table 3).

Table 3: Mean performance of the genotypes for various yield and yield contributing characters in M_3 generation

Treat-ment code.	Germination percentage	Days to 50% Flowering	Days to maturity	Plant height (cm)	No. of branches per plant	Pod length (cm)	No .of pods per plant	No. of seeds per pod	Grain yield per plant (g)	100 seed weight (g)	Sprouting percentage	Final plant count
V1T0	90.66	42.00	70.00	44.40	5.33	3.93	15.60	4.93	2.86	3.38	10.33	71.33
V1T1	98.33*	41.66	69.00	43.26	5.53	3.86	19.60*	4.46	3.57*	3.86*	12.93	83.00
V1T2	92.33	42.33	70.00	42.46	5.86	4.80*	21.80*	4.13	3.67*	4.09*	9.66	83.00
V1T3	93.66	42.33	68.66	46.40	4.40	4.33	19.20*	5.00	3.15	3.80*	18.66	84.00
V2T0	68.66	44.00	70.66	46.73	5.86	5.53	19.00	6.40	4.16	4.38	14.33	62.33
V2T1	92.33*	44.00	70.33	48.20	7.06*	4.53	35.40*	7.33*	5.62*	4.22	25.00	83.33
V2T2	81.00*	44.00	74.00	50.20	5.00	4.13	23.00*	7.33*	3.69	4.40	12.33*	87.66
V2T3	99.23*	44.33	74.00	56.06*	5.80	4.13	21.13	5.60	3.69	4.45	15.33	80.00
V3T0	78.00	44.00	71.00	45.26	4.80	4.50	28.86	5.93	4.67	4.30	11.00	86.00
V3T1	80.66	44.00	73.33	48.40	5.66	4.86	23.93	5.86	5.12	4.39	12.33	87.00
V3T2	96.00*	44.33	76.33	47.63	5.53	4.06	24.53	5.73	5.39*	4.53	19.00	96.00
V3T3	89.00*	44.66	75.00	45.53	6.93*	4.53	29.53	6.26	5.36*	4.30	16.33	88.00
Mean	88.32	43.47	71.86	47.04	5.65	4.43	23.46	5.75	4.25	4.18	14.77	82.63
SE(m)	1.67	0.55	1.22	1.86	0.30	0.21	0.93	0.12	0.23	0.11	0.55	5.74
F'test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	NS.
CD at 5%	4.91	1.62	3.60	5.46	0.88	0.64	2.74	0.35	0.68	0.35	1.63	16.85

V1 = Control T-9, V2 = Control TPU-4, V3 = Control AKU-18, T0 = 0kR, T1 = 15 kR, T2 = 25 kR, T3 = 35 kR

Table 3.2: Description of treatments

Treatment code	Genotype		Description of Treatment.
V1T0	T-9	-	Control (0kR)
V1T1	T-9	_	Irradiation with 15kR
V1T2	T-9	_	Irradiation with 25kR
V1T3	T-9	_	Irradiation with 35kR
V2 T0	TPU-4	_	Control (0kR)
V2 T1	TPU-4	_	Irradiation with 15kR
V2 T2	TPU-4	_	Irradiation with 25kR
V2 T3	TPU-4	_	Irradiation with 35kR
V3 T0	AKU-18	_	Control (0kR)
V3 T1	AKU-18	_	Irradiation with 15kR
V3 T2	AKU-18	_	Irradiation with 25kR
V3 T3	AKU-18	_	Irradiation with 35kR

Success in selecting a desirable plant type largely depends upon the genetic variability present in the base population, and mutation breeding offers the unique possibility of creation of new variation for crop improvement (Konzak, 1987).

The characters viz., sprouting percentage, number of pods plant^{-1}and grain yield plant^{-1}showed high GCV and PCV values indicating large amount of variation. Moderate and low GCV values recorded for the characters like number of branches plant^{-1}, number of seeds pod^{-1} days to 50 per cent flowering, days to maturity, 100 seed weight (g.) plant height(cm) and pod length (cm).

It reveals that the extent of genetic variation observed is considerably less for these characters among the genotypes

Table 4: Estimation of genetic parameter range, mean, GCV, PCV, heritability and genetic advance for various yield and yield contributing characters M_3 generation

Sr. no.	Characters	Range	Mean	GCV %	PCV %	Heritability %	GA	EGA as % over mean
1	Days to 50% Flowering	41.66-44.66	43.47	2.07	3.03	46.90	1.27	2.92
2	Days to maturity	68.66-75	71.86	3.09	4.28	52.10	3.30	4.60
3	Plant height(cm)	42.46-56.06	47.04	6.56	9.49	47.70	4.39	9.33
4	No. of branches per plant	4.40-7.06	5.65	12.63	15.65	65.10	1.18	21.00
5	Pod length(cm)	3.86-5.53	4.436	9.42	12.72	54.90	0.63	14.38
6	No. of pods per plant	15.60-35.40	23.46	23.10	24.12	91.80	10.70	45.60
7	No. of seeds per pod	4.13-7.33	5.75	17.47	17.84	95.90	2.02	35.24
8	Grain yield per plant (g.)	2.86-5.62	4.25	21.64	23.62	84.00	1.73	40.87
9	100 seed weight (g.)	3.38-4.53	4.18	7.54	9.03	69.90	0.54	12.99
10	Sprouting percentage	9.66-25	14.77	29.75	30.45	95.40	8.84	59.86

studied. There was no significant difference observed between GCV and PCV values for almost all the characters indicating less influence of environments. But PCV values were slightly higher than corresponding values of GCV for all the traits. These results are in conformity with finding of earlier workers Mehetre *et al*. (1995) in soybean, Borah and khan (2000) in fodder cowpea.

With the genetic coefficient of variation alone, it is difficult to determine the relative amount of heritable and non-heritable components of variations present in the population. Estimates of heritability and genetic gain would be supplement to this parameter. The highest heritability estimate in broad sense (h^2) were noted for the characters number of seeds per pod^{-1} followed by sprouting percentage and number of pods $plant^{-1}$ similar result obtained by Rajput *et al*. *(*1987), for the characters number of branches $plant^{-1}$ had the highest estimate followed by 100 seed weight, pods $plant^{-1}$, pod length, seed per pod, plant height and grain yield $plant^{-1}$in blackgram, Shakoor *et al*. (1978) in mungbean for 10 kR to 40 kR gamma ray treatment. Moderate values of heritability estimates in broad sense (h^2) were recorded for grain yield $plant^{-1}$. Low values of heritability estimates in broad sense (h^2) were observed for the characters, days to 50 per cent flowering, plant height, days to maturity, pod length, number of branches $plant^{-1}$ and 100 seed weight. Sinha and Bharati (1990) also find similar result obtained in mutant population of urdbean observed wide range for all the characters.

Heritability estimates alone is not of any use in predicting the results about the selection unless it is accompanied by genetic advance. The expected genetic advance (EGA) expressed as percentage over mean was estimated for different characters and results are presented in Table 4.5. The results indicated that the expected genetic advance over mean observed was in the range of 2.92 per cent to 59.86 per cent for different characters. The highest percentage of expected genetic advance was noted for the characters sprouting percentage, number of pods $plant^{-1}$, and grain yield $plant^{-1}$. These results are in conformity with finding of earlier workers Mehetre *et al*. (1995) in soybean and Borah and khan (2000) in fodder cowpea.

Moderate values of expected genetic advance were recorded for number of branches $plant^{-1}$ and number of seeds per pod. Low values of expected genetic advance were observed for the characters, days to 50 per cent flowering, days to maturity, plant height (cm), 100 seed weight (gm) and pod length.

High heritability accompanied with high genetic advance in a characters suggest that the inheritance of such character is mainly governed by additive gene effects and therefore selection based on phenotypic performance proved useful. During the present study, the expression for number of pods $plant^{-1}$ is predominantly governed by additive gene effects and therefore selection based on phenotypic performance will be useful to improve this character in future. More, over it is seen that this traits have less influence of the environment. Similar results were obtained by Pathania *et al*. (2010). Talukdar and Biswas (2008) recorded high heritability values for days to 50 per cent flowering (M2 andM_3); 100 seed weight (M3) and seed yield $plant^{-1}$ (M_3). High heritability together with significant genetic advance were noted for plant height (M_2 and M_3); branches $plant^{-1}$ and pods $plant^{-1}$ (M_2) and seed yield $plant^{-1}$ (M2 and M3) in soybean.

In the present study, the estimates of high heritability along with low genetic advance was observed for the characters grain yield $plant^{-1}$, sprouting percentage and number of seeds pod^{-1} indicated the pre dominance of non additive gene effect. When heritability is predominantly due to non-additive gene effects (dominance and epitasis) then the genetic gain by selection would be low, as observed in present study for these characters.

Therefore, recurrent selection may be employed to carry out further improvement for these characters. They recorded highest values of genotypic variance and phenotypic variance for seed size and lowest values of GCV and PCV for length of pods.

Low heritability accompanied with low genetic advance were observed for the characters viz. days to 50 per cent flowering, days to maturity, plant height(cm), number of branches $plant^{-1}$, pod length (cm),100 seed weight (g). It indicates that these characters is highly influenced by environmental effects and selection would be ineffective.(Table 4).

REFERENCES

Allard, R. W. 1960. Principles of Plant Breeding. *J. Wiley and Sons, Inc.* New York. pp.

Anju Pathania, Sood, B. C. and Bhateria, S. 2010. Genetic architecture of radiation induced variability for quantitative traits in chickpea (*Cicer arietinum* L.). *Legume Research*. **34(3):** 155-165.

Borah, H. K. and Khan, A. K. F. 2000. Variability, heritability and genetic advance in fodder cowpea. *Madras Agric. J*. **87(1):** 75 -90.

Conger, B. V., Skinner, L. W. and Skold, L. N. 1976. Variability for components of yield induced in soybean by seed treatment with gamma radiation, fission neutron and ethyl-methane sulfonate. *Crop Sci*. **16(2)**: 233-236.

Khan, I. A. 1983. Mutation studies in mungbean (*Phaseolus aureus*) induced polygenic variability after seed treatment. *Canadian J. Genet. and Cytol*. **25(3)**: 298-303.

Konzak, C. F. 1987. Mutations and Mutation breeding. In: wheat and wheat improvement. Edited by E.G. Heyne (American society of Agronomy) Madison. W.I. pp. 428-443.

Kundu, S. K. and Singh, D. P. 1981. EMS-induced variability in black gram. *Crop Improvement*. **8**: 71-72.

Lukoki, L., Marechal, R. and Otoul, E. 1980. Les ancetres sauvages des haricots cultives: *Vignaradiata* (L.) Wilczek et *V.mungo* (L.) Hepper. Bull. *Jard. Bot. Nat. Belgique*. **50**: 385-391.

Mehetre, S. S., Mahajan, C. R., Desai, N. S. and Shinde, R. B. 1995.Variability, heritability and character association in M_3 Families of gamma rradiated soybean. *Genet. Newsletter*. **22**: 125-131.

Mensah, J. K. and Akomeah, P. A. 1992. Mutagenic effects of hydroxylamine and streptomycin on the growth and seed yield of cowpea (*Vigna unguiculata* (L.) Walp.). *Legume Research*. **15(1)**: 39-44.

Nag, N., Sharma, S. K. and Kant, A. 2006. Agronomic Evaluation of some induced mutants of urdbean (*Vigna mungo* (L.) Hepper). *SABRAO J. Breeding and Genetics*. **38(1):** 29-38.

Panse, V. G. and Sukhatme, P. V. 1954. Statistical methods for agricultural workers, New Delhi ICAR publication. pp.

Rajput, M. A. 1974. Increased variability in M_2 of gamma irradiation in mungbean. *Rad. Bot*. **14**: 84-85.

Singh, D. P., Vidya, K. R. and Bhatia, D. D. 1979. Gamma ray induced variability for flowering and chlorophyll mutations in green gram. *Indian J. Agric. Sci*. **49(11)**: 835-838.

Singh, V. P., Singh, M.and Pal, J. P. 2000. Gamma ray and EMS induced genetic variability for quantitative traits in urdbean (*Vigna mungo* (L) Hepper). *Indian J. Genet*. **60(1):** 89-96.

Sinha, R. P. and Bharati, R. C. 1990. Variability in mutant populations of urdbean *(Vigna mungo*(L) Hepper.). *J. Nuclear Agric. Biol*. **19**: 44-46.

Shakoor, A. Ahsaan Ul Haq, M. and Sadiq, M. 1978. Induced variation in mungbean (*V. radiata* L.). *Environ. and Expt. Bot*. **18**: 169-175.

Sharma, A. K., Singh, V. P. and Kumar, V. 2008. Induction and characterization of macro-mutations in urdbean. *J. Food Legumes* **21(4):** 227-230.

Srivastava, A. and Singh, V. P. 1996. Induced high yielding *Pigeonpea* mutants. *Mutation Breeding Newsletter* **42**: 8-9.

Talukdar, D. and Biswas, A. K. 2008. Variability, heritability and scope of selection for some quantitative traits in induced mutant lines of grass pea (*Lathyrus sativus* L.). *International J. Plant Sciences* (Muzaffarnagar). **3(2):** 528-530.

Verma, R. K. and Singh, D. P. 1984. Gamma rays induced variability in green gram. *Ind. J. Agric. Sci.* **54(4):** 277-279.

Waghmare, V. N. and Mehra, R. B. 2000. Induced genetic variability for quantitative characters in grasspea. *Ind. J. Genet.* **60(1)**: 81-87.

Zeven, A. C. and De Wet, J. M. J. 1982.. Dictionary of cultivated plants and their regions of diversity. *Centre for Agricultural Publication and Documentation, Wageningen*. pp.

INSTRUCTION TO AUTHORS

The Bioscan

An International Quarterly Journal of Life Science

THE JOURNAL

The Bioscan is an international quarterly journal of life sciences with international editorial board. The journal is online and details can be seen (downloaded from the site. www.thebioscan.in). For any query e-mail at m_psinha@yahoo.com & dr.mp.sinha@gmail.com can be used.

AIM & SCOPE

The journal aims to publish original peerly reviewed/ refereed research papers/reviews on all aspects of life sciences.

SUBMISSION OF MANUSCRIPT

Only original research papers are considered for publication. The authors may be asked to declare that the manuscript has not been submitted to any other journal for consideration at the same time. Two hard copies of manuscript and one soft copy, complete in all respects should be submitted. The soft copy can also be sent by e-mail as an attachment file for quick processing of the paper.

FORMAT OF MANUSCRIPT

All manuscripts must be written in English and should be typed double-spaced with wide margins on all sides of good quality A4 paper.

First page of the paper should be headed with the title page, (in capital, font size 16), the names of the authors (in capitals, font size 12) and full address of the institution where the work was carried out including e-mail address. A short running title should be given at the end of the title page and 3-5 key words or phrases for indexing.

The main portion of the paper should be divided into Abstract, Introduction, Materials and Methods, Results, Discussion (or result and discussion together), Acknowledgements (if any) References and legends.

Abstract should be limited to 200 words and convey the main points of the paper-outline, results and conclusion or the significance of the results.

Introduction should give the reasons for doing the work. Detailed review of the literature is not necessary. The introduction should preferably conclude with a final paragraph stating concisely and clearly the aims and objectives of your investigation.

Materials and Methods should include a brief technical description of the methodology adopted while a detailed description is required if the methods are new.

Results should contain observations on experiment done illustrated by tables and figures. Use well known statistical tests in preference to obscure ones.

Discussion must not recapitulate results but should relate the author's experiments to other work on the subject and give their conclusions.

All tables and figures must be cited sequentially in the text. Figures should be abbreviated to Fig., except in the beginning of a sentence when the word Figure should be written out in full.

The figures should be drawn on a good quality tracing/ white paper with black ink with the legends provided on a separate sheet. Photographs should be black and white on a glossy sheet with sufficient contrast.

References should be kept to a minimum and listed in alphabetical order. Personal communication and unpublished data should not be included in the reference list. Unpublished papers accepted for publication may be included in the list by designating the journal followed by "in press" in parentheses in the reference list. The list of reference at the end of the text should be in the following format.

1. **Witkamp, M. and Olson, J. S. 1963.** Breakdown of confined and non-confined Oak Litter.*Oikos*. **14**:138-147.
2. **Odum, E.P. 1971.** *Fundamentals of Ecology*. W. B. Sauder Co. Publ. Philadelphia.p.28.
3. **Macfadyen, A.1963.** The contribution of microfauna to total soil metabolism. In:*Soil organism*, J. Doeksen and J. Van Der Drift (Eds). North Holland Publ. Comp., pp 3-16.

References in the text should be quoted by the **author's name and year** in parenthesis and presented in year order. When there are more than two authors the reference should be quoted as: first author followed by *et al.,* throughout the text. Where more than one paper with the same senior author has appeared in on year the references should

Cont. ..... P. 1368