International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 1, 2019, pp.-7728-7731.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

CROP ESTABLISHMENT METHODS AND NITROGEN MANAGEMENT IN ORGANICALLY GROWN SCENTED RICE (*ORYZA SATIVA*)- VEGETABLE PEA (*PISUM SATIVUM*) RELAY CROPPING SYSTEM

P. BHARALI AND K. THAKURIA*
Department of Agronomy, Assam Agricultural University, Jorhat, 785013, Assam, India
*Corresponding Author: Email - milonjyotikonwar20@gmail.com

Received: December 30, 2018; Revised: January 10, 2019; Accepted: January 12, 2019; Published: January 15, 2019

Abstract: A field experiment on a local scented rice var. 'Kola joha' was carried out under rainfed condition in the organic block located at the Instructional-cum Research Farm of Assam Agricultural University, Jorhat during kharif and *rabi* seasons of 2016-17 to study the effects of different crop establishment methods and nitrogen management practices through organic sources in scented rice-pea relay cropping system. Results revealed that almost all the growth and yield attributes as well as grain and straw yields of rice were recorded highest when transplanting was done with 60 (30+30) days old double planted seedlings. The total uptake (grain + straw) of N, P and K by rice crop was significantly higher with the same crop establishment method over the other methods. Most of the yield attributes, yield of green pods and stover as well as uptake of nutrients by pea sown as relay with rice were not influenced significantly due to different crop establishment methods. Among the nitrogen management practices application of 100% recommended dose of nitrogen (RDN) through FYM equivalent to 20 kg N/ha produced the highest grain and straw yields. The total rice grain equivalent yield, net returns and benefit-cost ratio were recorded highest when transplanting was done with 60 (30+30) days double planted seedlings and 100% RDN applied through FYM in scented rice. A slight grain in residual soil N and K_2O but loss in P_2O_5 were obtained in all the crop establishment methods and nitrogen management practices at the end of the experiment.

Keywords: Crop establishment, Nitrogen management, Organic, Pea, Relay cropping, Scented rice

Citation: P. Bharali and K. Thakuria (2019) Crop Establishment Methods and Nitrogen Management in Organically Grown Scented Rice (Oryza sativa)- Vegetable Pea (Pisum sativum) Relay Cropping System. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 1, pp.- 7728-7731.

Academic Editor / Reviewer: Dr Prashant Shrivastava, Dr Roy Stephen

Introduction

Rice is the major cereal food crop of Assam occupying an area of 24.88 lakh hectares with a production of 51.28 lakh tonnes [1]. Out of all the traditional scented rice varieties grown in Assam, 'Kola joha' is a popular long duration variety (150-160 days) with strong aroma, superfine kernel, good cooking quality and excellent palatability. Organic agriculture is gaining popularity day by day due to its eco-friendly nature. It is established globally that organic farming can improve the quality of scented rice. Nutrient management specially nitrogen through organic source is one of most important aspects in organic rice cultivation. Among the organic sources, farmyard manure (FYM) and vermicompost (VC) are the two major sources of nutrients and are easily available. However, the productivity of organic rice is low for which it is important to follow proper organic management including balance nutrition with organic sources of nutrients for higher productivity and better grain quality. Among the methods of crop establishment, sowing of pre-germinated rice seeds in puddled field reduces the demand of labour. Use of optimum age of seedlings at the time of transplanting has significant influence on yield of rice. Again, the practice of double transplanting of rice avoids the ill effects of overaged seedlings in the nursery and also useful in seedling scarcity situations. In Assam, most of the land after harvest of *kharif* (sali) rice remains fallow upto the next *kharif* season. In these lands' pea crop can be grown successfully as relay with sali rice. The crop can utilize the residual soil moisture and leftover nutrients applied to Sali rice and satisfactory yield can be achieved with minimum cost. The present study was undertaken to find out the proper method of crop establishment and nitrogen management practices in organically grown scented rice-pea relay cropping system.

Materials and Methods

A field experiment was conducted under rainfed condition in the organic block located at the Instructional-cum Research Farm of Assam Agricultural University, Jorhat during *kharif* and *rabi* seasons of 2016-17. The soil of the experimental field was sandy-loam in texture with pH 5.9, medium in organic carbon (0.58%), available P_2O_5 (23.40 kg/ha) and available K_2O (172.27 kg/ha) but low in available N (267.80 kg/ha). The experiment was carried out in randomized block design with three replications. The treatments consisted of five crop establishment methods *viz*., M_1 – Dibbling sprouted seeds in puddled field, M_2 – Transplanting of 30 DNS, M_3 – Transplanting of 60 DNS, M_4 – Transplanting of 60 (30+30) days DPS and M_5 – Transplanting of 30 DNS and one third of tillers/hill removed at 30 DAT along with four nitrogen management practices *viz*., N_0 – Control, N_1 – 100% RDN (FYM), N_2 – 100% RDN (VC) and N_3 – 50% RDN (FYM) + 50% RDN (VC). The required quantity of organic manures *viz*., FYM and VC was estimated and applied as per treatment based on recommended nitrogen dose (20 kg N/ha) and contents of nitrogen (N) and dry matter (DM) in respective manures. The laboratory analyses of different manure samples before application in the field revealed 0.5% N in FYM and 1.25% N in VC as well as 40.24% DM in FYM and 62.34% DM in VC. Transplanting/sowing of local scented rice variety, 'Kola joha' was done as per treatment at a spacing of 20 cm x 15 cm on 19 July and harvested on 22 November, 2016. Overnight soaked pea seeds (Azad P-1) were broadcasted as relay crop on 2 November, 2016 at the flowering stage of rice crop. The green pods of pea were harvested twice on 9 and 15 February, 2017, afterwards the plants were uprooted for stover. Growth parameters, yield components, grain/green pod and straw/stover yield at maturity in both the crops were recorded and estimated following standard methods. The concentration of N, P and K in soil and plant were determined using standard procedures and total uptake of nutrients by rice and pea was calculated multiplying the concentration with their respective dry matter (grain and straw) yield.

The economic parameters like net returns and benefit-cost ratio were worked out based on prevailing market price of inputs and labour wages. Total rainfall received during both the crop growing period was 1629.3 mm distributed in 38 rainy days.

Results and Discussion

Scented rice

Among different crop establishment methods, the grain and straw yields of rice were significantly higher in the method following 60 (30+30) days old double planted seedlings (M_4) over the other methods [Table-4] and the lowest was recorded with the method, dibbling sprouted seeds in puddle field (M_1). Higher yield with the use of 60 (30+30) days double planted seedlings might be due to significant increase in length of panicle, weight of panicle, number of filled grains per panicle and 1000 grain weight and decrease in percent unfilled grains per panicle [Table-2]. The increase in grain yield due to adoption of 60 days old double planted seedling method (M_4) over the methods M_5, M_3, M_2 and M_1 was 18.3, 20.5, 24.3 and 33.2 percent. The corresponding increase in straw yield was 15.6, 14.2, 15.2 and 39.7 percent. It has been observed that use of double planted seedlings in the method, M_4 recorded higher grain and straw yields over transplanting of nursery raised seedlings of either 30 or 60 days old (M_2, M_3 and M_5) and more prominently over the method M_1, when sprouted seeds were dibbled in puddled soil. The results corroborate the findings of Singh *et al*. (1990) [2]. Double planted seedlings had a thicker culm, taller seedling height and better shoot and root growth and thereby more food reserves in comparison to conventional seedlings [Table-1]. This might probably led to quick establishment of seedlings in main field and production of nodal and basal tillers which ultimately contributed towards higher grain and straw yields. Sarma *et al*. (2010) also reported that transplanting double planted seedlings of 60 (30+30) days old either in July or August resulted in higher yield as compared to transplanting with 60 days old normal nursery seedlings [3]. The use of double planted seedlings had beneficial advantage for higher production as reported by Singh and Thakur (1991), Ghosh (2006), Rautaray (2006) and Thakuria *et al*. (2017) [4-7]. Different organic nitrogen management practices significantly influenced the yield attributes *viz*., filled grains/panicle and length of panicle as well as grain and straw yields of scented rice. Application of 100% RDN through FYM recorded significantly higher values in all the characters over the other sources of application. the increase in grain yield of rice due to application of 100% RDN (FYM), 100% RDN (VC) and 50% RDN (FYM) + 50% RDN (VC) over the control was 16.2, 13.9 and 14.7 percent, respectively. The corresponding increase in straw yield was 16.4, 6.7 and 10.7 percent. This might be due to improved soil organic matter and slow mineralization rate of organic sources of nitrogen which helped in nutrient availability and uptake for longer period. Similar findings were also reported by Kharub and Chander (2008), Davari and Sharma (2010) and Banerjee *et al*. (2013) [8-10].

Relay crop pea

All the yield attributing characters and yield of succeeding pea crop grown as relay with rice showed non-significant differences among all the crop establishment methods except for number of seeds/pods [Table-3] when the highest value was recorded with the use of 60 (30+30) days double planted seedlings (M_4) followed by 30 DNS method (M_2). Higher value recorded with the method, M_4 might be due to favourable association between both the crops which showed positive response to the growth of pea crop and efficient use of soil moisture owing to heavy canopy cover of rice. similar results were also reported by Agrawal *et al*. (1987) and Kalita (1999). None of the organic nitrogen management practices could influence significantly the yield and yield attributing characters of pea crop [11,12].

Total rice grain equivalent crop

On the basis of scented rice-pea (vegetable) relay cropping system [Table-4] the highest rice grain equivalent yield (3.70 t/ha) was recorded when transplanting of 60 (30+30) days of double planted seedlings (M_4) was done which was followed by transplanting 30 DNS and one third tillers/hill removed at 30 DAT (M_5) and transplanting of 60 DNS (M_3). The increase in rice grain equivalent yield due to M_4, M_5, M_3 and M_2 methods of crop establishment over the method, dibbling of sprouted seeds in puddled soil (M_1) was 36.8, 23.5, 19.3 and 17.0 percent, respectively. Application of FYM at 100% RDN (N_1) recorded the highest rice grain equivalent yield due to higher production obtained in both the crops under this treatment. The increase in rice grain equivalent yield due to organic sources of nitrogen management *viz*., N_1, N_2 and N_3 over the unmanured control (N0) was 16.1, 10.7 and 12.5 percent, respectively.

N, P, K uptake and nutrient status in soil after the system

The highest total uptake of N, P and K by rice and pea [Table-5] was found in transplanting of 60 (30+30) days old double planted seedlings (M_4) and application of 100% RDN through FYM (N_1). The available N, P and K status in soil after harvest of pea crop showed that a slight gain in residual soil N (+0.07 to +0.37%) and K_2O (0.17 to +1.80%) but loss in P_2O_5 (-21.4 to -26.9%) over the initial status was noted among all the crop establishment methods. The maximum gain in residual soil N (0.37%) was recorded in M_1, M_3 and M_5 methods, K_2O (+1.80%) in M_1 method and maximum loss of P_2O_5 (-26.9%) in M_2 method of crop establishment. This might be due to comparatively lower crop yield than M_4 method, resulting lower uptake in other methods of crop establishment. Nitrogen economy with winter legumes was also reported by Ahlawat *et al*. (1981) [13]. Maximum loss in residual available soil N (-3.63%), P_2O_5 (-36.7%) and K_2O (-7.43%) was recorded in unmanured control plot (N0) due to successive depletion of soil inherent nutrient status during the period of experiment. The results are in close conformity with the findings of Banerjee *et al*. (2013). Actual gain in residual soil N (+0.85 to +2.23%) and K_2O (+1.68 to +5.57%) was noted in all the organic nitrogen management treatments except the control, however, loss in residual soil P_2O_5 (-12.8 to -27.8%) was obtained in all the crop establishment methods and nitrogen management practices followed in the study.

Economics of rice-pea relay cropping

On system basis, the highest net return (Rs. 1,08,900/ha) and benefit-cost ratio (2.78) were obtained with transplanting of 60 (30+30) days DPS (M_4). This is due to higher rice grain equivalent yield obtained in M_4 method. The results are in close conformity with the findings of Rautaray (2006) and Ashem *et al*. (2010) [14]. The highest net return (Rs. 92,495/ha) and benefit-cost ratio (2.69) were recorded with the application of 100% RDN (FYM) which may be due to low cost of the source and highest rice grain equivalent yield. The results corroborate the findings of Singh (2011) and Banerjee *et al*. (2013).

Conclusion

On the basis of findings, it can be concluded that transplanting of 60 (30+30) days old double planted seedlings with application of 100% RDN through FYM was the best for obtaining higher production and maximum monetary returns in scented rice-pea (vegetable) relay cropping system.

Application of research: Study of application of FYM

Research Category: Agronomy

Abbreviations: FYM: Farmyard Manure

Acknowledgement / Funding: Authors are thankful to Department of Agronomy, Assam Agricultural University, Jorhat, 785013, Assam, India

***Research Guide or Chairperson of research: Dr K. Thakuria**
University: Assam Agricultural University, Jorhat, 785013, Assam, India
Research project name or number: PhD Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Table-1 *Seedling quality of rice at different duration (ages)*

*Seedling quality/ growth parameter	30 DNS	60 DNS	60 (30+30) DPS
Shoot length (cm)	47.1	52.5	60.1
Root length (cm)	7.0	8.2	9.2
Number of leaves/seedling	4.0	5.0	7.0
Number of tillers/hill	-	-	12.0
Dry matter (g)/seedling or tiller	1.01	1.61	7.50

*DNS-Days nursery seedling, DPS-Double planted seedling, * Mean of 10 seedlings/tillers*

Table-2 *Growth and yield attributes of scented rice as influenced by crop establishment methods and nitrogen management*

Treatment	Plant height (cm)	Panicles/ m^2	Length of panicle (cm)	Weight of panicle (g)	Filled grains/ panicle	Percent unfilled grains/ panicle	1000 grain weight (g)
Crop establishment methods (M)							
M_1: Dibbling sprouted seeds in puddled field	122.2	307.6	21.3	1.52	96.8	17.3	12.10
M_2: Transplanting 30 DNS	131.8	341.4	23.3	1.76	105.1	12.1	12.01
M_3: Transplanting 60 DNS	133.0	334.9	23.4	1.68	103.7	11.6	12.12
M_4: Transplanting 60 (30+30) days DPS	142.5	342.5	25.0	1.95	134.3	11.4	12.20
M_5: Transplanting 30 DNS and one third tillers/hill removed at 30 DAT	135.7	336.5	24.0	1.92	110.2	12.9	12.12
S.Em(±)	1.54	10.78	0.22	0.098	1.57	0.92	0.047
CD (P=0.05)	4.4	31.0	0.6	0.28	4.5	2.6	NS
Nitrogen management (N)							
N_0: Control	133.1	319.3	22.5	1.72	98.2	15.9	12.02
N_1: 100% RDN (FYM)	133.5	336.3	23.8	1.86	112.7	12.1	12.15
N_2: 100% RDN (VC)	132.1	337.6	23.6	1.75	115.3	12.4	12.11
N_3: 50% RDN (FYM) + 50% RDN (VC)	133.9	337.4	23.6	1.73	113.8	11.9	12.16
S.Em(±)	1.38	10.5	0.19	0.088	1.40	0.82	0.042
CD (P=0.05)	NS	NS	0.5	NS	4.0	2.3	NS

DNS -Days nursery seedling, DPS-Double planted seedling, DAT-Days after transplanting, RDN-Recommended dose of N@ 20 kg/ha, FYM-Farmyard manure, VC-Vermicompost, NS- Non-significant

Table-3 *Growth and yield attributes of relay crop pea as influenced by crop establishment methods and nitrogen management followed in rice crop*

Treatment	Plant height (cm)	Plant population/ m^2	No. of pods/ plant	No. of seeds/ pod	1000 green seed weight (g)
Crop establishment methods (M)					
M_1: Dibbling sprouted seeds in puddled field	32.4	27.2	3.5	2.3	394.46
M_2: Transplanting 30 DNS	36.8	25.3	3.7	2.8	423.26
M_3: Transplanting 60 DNS	34.7	30.2	3.6	2.4	398.16
M_4: Transplanting 60 (30+30) days DPS	37.8	26.3	3.5	3.0	452.03
M_5: Transplanting 30 DNS and one third tillers/hill removed at 30 DAT	35.9	28.7	3.5	2.5	374.43
S.Em(±)	1.22	1.8	0.14	0.17	22.283
CD (P=0.05)	3.5	NS	NS	0.5	NS
Nitrogen management (N)					
N_0: Control	35.6	25.9	3.3	2.6	432.18
N_1: 100% RDN (FYM)	36.7	28.4	3.7	2.9	392.83
N_2: 100% RDN (VC)	32.1	28.3	3.6	2.3	418.91
N_3: 50% RDN (FYM) + 50% RDN (VC)	37.8	27.6	3.6	2.6	389.95
S.Em(±)	1.09	1.6	0.12	0.16	19.921
CD (P=0.05)	3.1	NS	NS	NS	NS

DNS -Days nursery seedling, DPS-Double planted seedling, DAT-Days after transplanting, RDN-Recommended dose of N@ 20 kg/ha, FYM-Farmyard manure, VC-Vermicompost, NS- Non-significant

Table-4 *Yield of rice and pea, total rice grain equivalent yield and economics of scented rice-pea crop sequence as influenced by crop establishment methods and nitrogen management*

Treatment	Rice yield (t/ha)		Pea yield (kg/ha)		Total rice grain equivalent yield (t/ha)	Net return (Rs./ha)	B:C ratio
	Grain	Straw	Green pod	Stover			
Crop establishment methods (M)							
M_1: Dibbling sprouted seeds in puddled field	1.79	3.32 (0.415)	87.83 (0.109)	121.31 (0.021)	2.34	55,555	1.46
M_2: Transplanting 30 DNS	2.03	4.67 (0.584)	146.02 (0.183)	151.06 (0.026)	2.82	74,150	1.92
M_3: Transplanting 60 DNS	2.13	4.73 (0.591)	116.65 (0.146)	145.65 (0.025)	2.90	77,350	2.00
M_4: Transplanting 60 (30+30) days DPS	2.68	5.51 (0.688)	144.46 (0.180)	185.65 (0.032)	3.70	1,08,900	2.78
M_5: Transplanting 30 DNS and one third tillers/hill removed at 30 DAT	2.19	4.65 (0.581)	128.01 (0.160)	149.37 (0.026)	3.06	83,440	2.14
S.Em(±)	0.043	0.135	20.272	22.992	0.069	-	-
CD (P=0.05)	0.12	0.39	NS	NS	0.20	-	-
Nitrogen management (N)							
N_0: Control	1.91	4.17 (0.521)	118.89 (0.148)	144.54 (0.025)	2.66	77,095	2.63
N_1: 100% RDN (FYM)	2.28	4.99 (0.624)	148.27 (0.185)	168.10 (0.029)	3.17	92,495	2.69
N_2: 100% RDN (VC)	2.22	4.47 (0.559)	109.59 (0.137)	136.03 (0.023)	2.98	69,895	1.42
N_3: 50% RDN (FYM) + 50% RDN (VC)	2.24	4.67 (0.584)	121.63 (0.152)	154.56 (0.027)	3.04	79,795	1.91
S.Em(±)	0.038	0.122	18.130	19.833	0.061	-	-
CD (P=0.05)	0.11	0.35	NS	NS	0.18	-	-

(Figures in parentheses represent the percent increase (+) or decrease (-) over initial status), DNS -Days nursery seedling, DPS-Double planted seedling, DAT-Days after transplanting, RDN-Recommended dose of N@ 20 kg/ha, FYM-Farmyard manure, VC-Vermicompost, NS- Non-significant

Table-5 *Total (grain/pod) + straw/stover) nutrient uptake by rice and pea and residual soil fertility as influenced by crop establishment methods and nitrogen management*

Treatment	Total nutrient uptake (kg/ha)						Available nutrient status in soil (kg/ha)		
	N		P		K		N	P_2O_5	K_2O
	Rice	Pea	Rice	Pea	Rice	Pea			
Crop establishment methods (M)									
M_1: Dibbling sprouted seeds in puddled field	41.7	4.2	9.7	0.8	24.1	1.8	268.8 (+0.37)	18.4 (-21.4)	175.4 (+1.80)
M_2: Transplanting 30 DNS	53.3	6.5	12.3	1.3	31.9	2.5	268.0 (+0.07)	17.1 (-26.9)	172.6 (+0.17)
M_3: Transplanting 60 DNS	55.2	5.4	12.8	1.1	32.5	2.2	268.8 (+0.37)	18.3 (-21.8)	174.2 (+1.10)
M_4: Transplanting 60 (30+30) days DPS	68.5	6.7	15.6	1.4	38.9	2.8	268.4 (+0.22)	17.6 (-24.8)	173.1 (+0.46)
M_5: Transplanting 30 DNS and one third tillers/hill removed at 30 DAT	55.6	5.7	13.0	1.1	33.0	2.3	268.8 (+0.37)	18.1 (-22.6)	173.4 (+0.64)
S.Em(±)	1.11	0.71	0.29	0.16	0.79	0.24	0.28	0.54	0.69
CD (P=0.05)	3.2	NS	0.8	NS	2.3	NS	NS	NS	NS
Nitrogen management (N)									
N_0: Control	48.3	5.4	11.1	1.1	28.1	2.2	258.4 (-3.63)	14.8 (-36.7)	159.5 (-7.43)
N_1: 100% RDN (FYM)	58.8	6.6	13.7	1.4	35.1	2.7	270.1 (+0.85)	16.9 (-27.8)	175.2 (+1.68)
N_2: 100% RDN (VC)	55.5	5.0	12.8	1.0	32.1	2.1	271.9 (+1.51)	19.4 (-17.1)	178.1 (+3.37)
N_3: 50% RDN (FYM) + 50% RDN (VC)	56.8	5.8	13.0	1.1	33.2	2.3	273.9 (+2.23)	20.4 (-12.8)	181.9 (+5.57)
S.Em(±)	0.99	0.83	0.26	0.24	0.71	0.31	0.25	0.48	0.62
CD (P=0.05)	2.8	NS	0.7	NS	2.0	NS	0.7	1.4	1.8
Initial value	-	-	-	-	-	-	267.8	23.4	172.3

(Figures in parentheses represent the percent increase (+) or decrease (-) over initial status), DNS -Days nursery seedling, DPS-Double planted seedling, DAT-Days after transplanting, RDN-Recommended dose of N@ 20 kg/ha, FYM-Farmyard manure, VC-Vermicompost, NS- Non-significant

Conflict of Interest: None declared

Sample Collection: Instructional-cum Research Farm of Assam Agricultural University, Jorhat
Cultivar / Variety name: Kola joha

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Anonymous (2014) *Annual Report, Department of Agriculture and co-operation, Ministry of Agriculture, Government of India, Krishi Bhawan, New Delhi.*
[2] Singh G., Singh O.P. and Yadav R.A. (1990) *Oryza*, 27(2), 210-213.
[3] Sarma U.J., Bhattacharyya H.C., Chakravarty M. (2010) *International Journal of Agricultural Statistical Science*, 6(2), 435-440.
[4] Singh B.K. and Thakur R.B. (1991) *Oryza,* 28, 251-253.
[5] Ghosh A. (2006) *Indian Farming*, 56(1), 7-9.
[6] Rautaray S.K. (2006) *Indian Journal of Agricultural Science*, 76(8). 469-471.
[7] Thakuria K., Saud R.K. and Thakuria C. (2017) *Agricultural Science Digest*, 37(4), 294-297.
[8] Kharub A.S. and Chander S. (2008) *Indian Journal of Agronomy*, 53(3), 172-177.
[9] Davari M.R. and Sharma S.N. (2010) *Indian Journal of Agronomy*, 55(4), 290-294.
[10] Banerjee S., Ghosh M., Pal S.K., Mazumdar D. and Mahata D. (2013) *Oryza*, 50(4), 365-369.
[11] Agrawal S.K., Shrivastava P.S. and Singh R. (1987) *Rice abstract*, 10(5).
[12] Kalita J. (1999) *Effect of fertility and sowing density on rice-linseed relay cropping. M.Sc. (Agri.) thesis submitted to Assam Agricultural University, Jorhat.*
[13] Ahlawat I.P.S., Singh A. and Saraf C.S. (1981) *Experimental Agriculture*, 17, 57-62.
[14] Ashem S.S., Thakuria K. and Kurmi K. (2010) *Oryza*, 47(4), 328-330.