Environment and Ecology 39 (4A) : 1171—1177, October—December 2021
ISSN 0970-0420

Weed Dynamics, Growth pattern and productivity of Pearl millet (*Pennisetum glaucum*) as Influnced by Weed Control and Residue management Practices in Rainfed Semi-Arid Region of Rajasthan

Bhuli Devi Ghosalya, B.L. Dudwal, Ramesh Chand Bana

Received 26 August 2021, Accepted 10 October 2021, Published on 2 November 2021

ABSTRACT

The present investigation entitled "Effect of Weed Control and Residue Management on Pearl millet" was conducted during *kharif* seasons of 2015. The eighteen treatment combinations consisting of 6 weed control measures and 3 residue management practices were tested in Randomized Block Design with three replications. Results showed that weed control measure atrazine + one hand weeding at 25 DAS proved significantly superior to treatment control, one hand weeding at 15 DAS, atrazine and pendimethalin with respect to growth attributes and grain yield but it was at par with pendimethalin + one hand weeding at 25 DAS. The weed control measures atrazine, pendimethalin and one hand weeding at 15 DAS were being at par with each other and superior to control. The treatment atrazine + one hand weeding at 25 DAS and pendimethalin + one hand weeding at 25 DAS were being at par with each other and recorded significantly lower weed density, dry matter production and N, P, K depletion as well as higher weed control efficiency than control, one hand weeding at 15 DAS, atrazine and pendimethalin. Results further indicated that plant height, dry matter accumulation grain yield and weed control efficiency significantly increased with residue management practices over control and brown manuring was best in residue management practices. Significantly lower weed density, dry matter, weed infestation and N, P, K depletion recorded under brown manuring practice which was at par with application of mustard stover

Keywords Brown manuring, Pearl millet, Weed control, Residue management, Productivity.

INTRODUCTION

Pearl millet (*Pennisetum glaucum* (L.) R. Br. emend Stuntz), is one of the major coarse grain or millet crops and is considered to be a poor man's food. It is an important crop of rainfed areas of Africa and India. India and Africa together account for 93.2 % of the total pearl millet production of the world. Cultivation of pearl millet is mostly confined to the

Bhuli Devi Ghosalya, B.L. Dudwal*, Ramesh Chand Bana
Department of Agronomy, SKN Agriculture University, Jobner 303329, Rajasthan, India
Email : bldudwal.agro@sknau.ac.in
*Corresponding author

state of Rajasthan, Gujarat, Haryana, Uttar Pradesh and Maharashtra which account for more than 90% of pearl millet acreage in country. As pearl millet is grown predominantly in warm rainy season, weeds of different kinds deprive the crop of vital nutrients, moisture, light and space. Like other rainy season crops, pearl millet faces severe weed competition leading to heavy reduction in grain yield. On an average 20-30% yield reduction is recorded, but under humid rainy season and extremely weedy situations, it may be quite high. On an average, 55% yield reduction due to heavy weed infestation in pearl millet was observed by (Banga *et al*. 2000). The nutrient depletion by weeds in pearl millet are upto 61.8 kg N, 5.6 kg P and 57.6 kg K ha^{-1}, this was reported by (Baldev Ram *et al*. 2004). Weeds emerge along with the crop during rainy season, which cause serious competition with the crop plant during initial growth period of crop resulting in seed yield loss up to 40 % or more (Sharma and Jain 2003). Weed management practices i.e. hand weeding, interculturing operation by hoeing reduce 50% dose of herbicides (Johanson *et al*. 1998). As manual weeding in pearl millet is a costly and labor intensive method and also subject to the availability of labores during peak period, there is a need of chemical control of weeds through herbicides. The use of herbicides has revolutionized weed management and reduces the cost of cultivation. Therefore integrated approaches for weed management using chemical and manual methods were evaluated for weed management in pearl millet. The previous season crop residues on the soil surface seems to be better options due to its benefits in the form of soil and water conservation as it reduces the water losses due to evaporation. Surface retained residue also reduces the germination of weeds leading to lower weed infestation. Moreover, slow decomposition also helps in building up of soil organic carbons-a direct indicator of soil health. Therefore, the aim in this research was to understand the effects of weed and residue management in bajra under semi-arid condition.

MATERIALS AND METHODS

The present investigation entitled "Effect of Weed Control and Residue Management on Pearl millet" was conducted during *kharif* seasons of 2015 at research farm of S.K.N. College of Agriculture, Jobner, Rajasthan.Geographically experimental site falls under semi-arid climate of Rajasthan and is located at 260 05' North latitude, 75^0 28' East longitude and at an altitude of 427 meters above mean sea level. Soil of experimental field was loamy sand with saline in reaction (pH 8.32), low in organic carbon (0.18 %), low in available nitrogen (130.30 kg/ha), medium in phosphorus (18.90 kg/ha) and potassium (176.70 kg/ha). The field experiment was laid out in factorial Randomized Block Design with three replications. Eighteen treatment combinations involving six levels of weed control; control, one hand weeding at 15 DAS, atrazine, pendimethalin, atrazine + one hand weeding at 25 DAS and pendimethalin + one hand weeding at 25 DAS and three residue management practices; control, mustard straw @ 5 t/ha and brown manuring were included in this study. The allotment of treatments to various plots in each replication was done by referring random number. Pearl millet variety (Raj-171) was planting on 5th July 2015 in the rows spaced at 45 cm. The seeds were sown behind the plough in furrows by kera method using a seed rate of 4 kg /ha. Periodic growth parameters like plant height and dry matter accumulation were measured by randomly selected 5 plants from each experimental plot. All data were represented as average value of these 5 plants. The observation of yield was also recorded at harvest. Parameters like weed density and weed dry matter at given periodic interval was recorded by collecting the weed samples from 0.5 m^2 area in each experimental unit. After recording dry matter accumulation by weeds at harvest, samples were grind for estimation of N, P and K contents in weeds by employing the methods as Nesseler's reagents colorimetric method, Ammonium vanadomolybdo phosphoric acid yellow color method and Flame photometer method, respectively and expressed as per cent. Different indices like weed infestation,weed control efficiency and nutrient depletion by weeds were calculated as follows:

Weed infestation (WI) refers to the percentage of weeds in the composite population of weeds and crop plants and was calculated using the following eq. 01 (Nath *et al*. 2016).

$$WI\,(\%) = \frac{Total\ no.of\ weed\ inunit\ area}{Total\ no.of\ weeds\ and\ crop\ plant\ the\ same\ area} \times 100 \quad (1)$$

Weed control efficiency (WCE) reflects per cent reduction in weed density by a treatment, was determined using eq. 02 (Nath *et al.* 2016).

$$WCE\ (\%) = [\{(WPc - WPt) \times 100\}/WPc] \quad (2)$$

where, WPc and WPt are weed density in control and treated plots, respectively.

Nutrient depletion of these nutrients by weeds at harvest stage was estimated by using the following formula (eq. 03)

$$ND\ (kg/ha) = \frac{Nutrientconcentrationinweeds(\%) \times Weeddrymatteratharveststage\ (kg/ha)}{100} \quad (3)$$

All experimental data were analyzed using SPSS version 7.5. The data were subjected to analysis of variance and significant differences among treatments were tested by calculating CD at 5% level of significance differences evaluated by using one-way ANOVA (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Effect on growth and yield

Yield is highly dependent upon the growth of pearl millet crop. The significantly higher plant height and dry matter accumulation (DMA) were observed with W_5 at 60 DAS and at harvest, which was remained at par with treatment W6. Whereas, significantly lowest growth parameters were registered in control plot. These results are in accordance with the findings of Baldev Ram *et al.* (2005) and Mathukia *et al.* (2015). Significantly higher grain yield (19.19 q/ha) was recorded under the treatment W_5 than W_1, W_2, W_3¬ and W_4, but it was remained at par with treatment W6. The per cent increase in the grain yield over control was to the tune of 32.19 and 36.97% under treatments W6 and W_5, respectively. Treatments W_3 (17.82 q/ha), W_4 (17.16 q/ha) and W_2 (17.84 q/ha) were also remained statistically superior to W_1. The control plot registered significantly lower grain yield (14.01 q/ha) than all other treatments.Kiroriwal *et al.* (2012) Munde *et al*. (2012) also reported improvement in yield components due to elimination of severe crop weed competition.The residue management practices brought significant improvement in growth and grain

Table 1. Effect of weed control and residue management on growth and yield of pearl millet.

Treatments	Plant height (cm)		Dry matter accumulation		Grain yield
	60 DAS	At harvest	60 DAS	At harvest	(q/ha)
Weed control					
W_1 : Control	117.59	149.45	133.27	229.05	14.01
W_2 : One HW at 15 DAS	130.00	175.74	171.09	284.09	16.84
W_3 : Atrazine	138.27	181.50	177.11	294.75	17.82
W_4 : Pendimethalin	131.04	180.90	174.55	288.55	17.16
W_5 : Atrazine+one HW at 25 DAS	152.93	198.70	193.73	326.60	19.19
W_6 : Pendimethalin+one HW at 25 DAS	145.32	196.97	190.79	320.75	18.52
SEm+	3.50	5.42	4.70	8.72	0.45
CD (p=0.05)	10.07	15.57	13.51	25.06	1.30
Residue management					
R_1 : Control	116.45	150.24	134.54	229.51	13.88
R_2 : Mustard residue @ 5 t/ha	142.42	191.58	187.11	310.85	18.54
R_3 : Brown manuring	148.71	199.81	198.62	331.54	19.35
SEm+	2.48	3.83	3.32	6.17	0.32
CD (p=0.05)	7.12	11.01	9.55	17.72	0.92
Interaction effect	NS	NS	NS	NS	NS
CV (%)	7.74	9.00	8.13	9.00	7.85

yield of pearl millet. At both the stage, brown manuring significantly increased the plant height, DMA and finally grain yield of pearl millet, but was remained at par with the application of mustard straw @ 5 t/ha. The grain yield increase due to brown manuring over mustard straw and control was to the extent of 4.37 and 39.41%, respectively.The results obtained on growth attributes and yield is in close conformity with the findings of Kaur and Singh (2006), Regar *et al.* (2009), Ramachandran *et al.* (2012).The interaction effect of weed control and residue management practices did not have significant variation with respect to growth and grain yield of mustard.

Effect on weed density and weed dry matter

Mean data on total weed population counted from per 0.50 square meter area and weed dry matter (WDM) recorded at 30, 60 DAS and at harvest as affected by weed control and residue management practices are presented in Table 2. Pre-emergence application of atrazine + one hand weeding at 25 DAS recorded significantly lowest weed density (1.97, 3.86 and 3.21 number per 0.50 m^2 area at 30, 60 DAS and at harvest, respectively) and WDM (16.95, 282.50 and 776.79 kg/ha at 30, 60 DAS and at harvest stages, respectively) over treatments control, one hand weeding at 15 DAS, pendimethalin and atrazine whereas it was remained at par with pendimethalin + one hand weeding at 25 DAS. Significantly the higher weed density and WDM was counted in control than all other weed management practices. Superiority of treatment atrazine + one hand weeding at 25 DAS with respect to lower weed density and dry matter production of weeds was mainly due to the fact that, weeds were controlled by hand weeding and atrazine exerts phytotoxic effect on weeds by inhibiting photosystem II and electron transport system. The results are in conformity with those reported by Baldev *et al*. (2005), Kiroriwal *et al*. (2012) and Mathukia *et al.* (2015). Number of weeds per 0.50 m^2 area and WDM at 30, 60 DAS and at harvest significantly, reduced due to the residue management practices than control (Table 2). The practice of brown manuring by and large surpassed over control at all the stages of observation. Further, mustard straw was found equally effective in controlling weeds. The brown manuring practice registered 55.35 and 6.25\% less weed density and 85.80 and 14.58% less WDM at harvest than control and application of mustard straw, respectively.Corroborative finding were also reported by Anitha *et al*. (2012), Seema *et al.* (2015). The interaction effect of weed control and residue management practices was found significant with respect to weed

Table 2. Effect of weed control and residue management on weed density and weed dry matter in pearl millet.

Treatments	Weed density per 0.5 m^2 area			Weed dry matter (kg/ha)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Weed control						
W_1 : Control	7.19	12.32	10.36	479.18	2670.62	5392.28
W_2 : One HW at 15 DAS	5.04	6.71	5.19	159.67	523.94	1410.41
W_3 : Atrazine	4.67	6.16	5.07	146.58	464.16	1258.16
W_4 : Pendimethalin	4.93	6.45	5.13	152.59	485.06	1383.83
W_5 : Atrazine+one HW at 25 DAS	1.97	3.86	3.21	16.95	282.50	776.79
W_6 : Pendimethalin+one HW at 25 DAS	2.17	3.99	3.34	18.07	316.52	831.84
SEm+	0.15	0.22	0.15	5.51	22.93	53.24
CD (p=0.05)	0.42	0.63	0.42	15.83	65.89	153.02
Residue management						
R_1 : Control	8.17	9.49	8.40	340.40	1340.80	4224.20
R_2 : Mustard residue @ 5 t/ha	2.54	5.28	4.00	78.12	628.20	702.45
R_3 : Brown manuring	2.28	4.98	3.75	68.00	402.40	600.00
SEm+	0.10	0.16	0.10	3.89	16.21	37.65
CD (p=0.05)	0.30	0.45	0.30	11.19	46.59	108.20
Interaction effect	Sig	Sig	Sig	Sig	Sig	Sig
CV (%)	10.24	10.01	8.23	10.19	8.70	8.67

density and WDM both.The results indicated that significantly lower weed density (number of weeds per 0.50 m^2 area) and WDM (kg/ha) 1.04 and 7.11, 2.92 and 143.81 and 2.24 and 253.00 at 30, 60 DAS and at harvest, respectively was registered under the treatment combination W_5R_3, it superseded over rest of the treatment combinations except the treatment combination W_6R_3, W_5R_2 and W_6R_2. Significantly higher weed density and WDM was noticed under the treatment combination W_1R_1 than all other treatment combinations. It might be due to synergistic effect of smothering action of brown manuring coupled with herbicidal effect on weeds proved effective against all type of weeds. Sesbenia reduce weed population and dry matter of weeds due to shading effect exerted by the canopy of. Moreover, 2, 4-D is a selective herbicide recommended for broad leaf weeds and sedges. The findings are closed conformity of results obtained by Maity and Mukherjee (2009), Chongtham *et al.* (2015).

Effect on weed indices

Pre-emergence application of atrazine + one hand weeding at 25 DAS recorded significantly lowest W_I (21.22, 36.06 and 32.55% at 30, 60 DAS and at harvest, respectively) and WCE (96.46, 89.42 and 85.59% at 30, 60 DAS and at harvest, respectively) over treatments control, one hand weeding at 15 DAS, pendimethalin and atrazine whereas, it was remained at par with pendimethalin + one hand weeding at 25 DAS (Table 3). Among all the treatment, significantly higher weed were counted in control plot. The treatment W_3, W_4 and W_2 were being at par with each other. The results are in conformity with those reported by Kaur and Singh (2006) and Mathukia *et al.* (2015). The practice of brown manuring by and large surpassed over control at all the stages of observation. Further, mustard straw was found equally effective in controlling weeds. The brown manuring practice recorded significantly lowest W_I 24.49, 41.60 and 35.69% at 30, 60 DAS and at harvest, respectively. whereas, the significantly maximum weed infestation (52.56, 59.37 and 55.84% at 30, 60 DAS and at harvest, respectively) recorded under control. Brown manuring also recorded maximum weed control efficiency 80.02, 69.99 and 85.80 % at 30, 60 DAS and at harvest, respectively.Interactive effect between weed control and residue management practices was found non-significant with respect to weed infestation at different observation stages and might be due to reduction in weed population and dry matter. The organic residue suppressing weed growth could be attributed to its smothering effect on weeds.

Table 3. Effect of weed control and residue management on weed indices in pearl millet.

Treatments	Weed infestation (%)			Weed control efficiency (%)		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
Weed control						
W_1 : Control	47.42	66.07	61.00	00.00	00.00	00.00
W_2 : One HW at 15 DAS	39.39	50.92	44.27	66.68	80.38	73.84
W_3 : Atrazine	37.51	48.32	43.00	69.41	82.62	76.67
W_4 : Pendimethalin	38.79	50.16	43.66	68.16	81.84	74.34
W_5 : Atrazine+one HW at 25 DAS	21.22	36.06	32.55	96.46	89.42	85.59
W_6 : Pendimethalin+one HW at 25 DAS	22.77	37.38	33.48	96.23	88.15	84.57
SEm+	1.20	1.47	1.35	2.24	2.19	2.39
CD (p=0.05)	3.45	4.21	3.87	6.48	6.33	6.93
Residue management						
R_1 : Control	52.56	59.37	55.84	00.00	00.00	00.00
R_2 : Mustard residue @ 5 t/ha	26.51	43.48	37.45	77.05	53.15	83.37
R_3 : Brown manuring	24.49	41.60	35.69	80.02	69.99	85.80
SEm+	0.85	1.04	0.95	1.73	1.69	1.85
CD (p=0.05)	2.44	2.98	2.74	5.02	4.91	5.37
Interaction effect	NS	NS	NS	NS	NS	NS
CV (%)	10.42	9.13	9.40	8.45	7.76	9.09

Table 4. Effect of weed control and residue management on nutrient concentration and depletion by weeds in pearl millet.

Treatments	Concentration in weed (%)			Depletion by weed (kg/ha)		
	N	P	K	N	P	K
Weed control						
W_1 : Control	1.599	0.129	1.384	85.85	6.93	74.32
W_2 : One HW at 15 DAS	1.591	0.128	1.370	22.34	1.80	19.24
W_3 : Atrazine	1.571	0.125	1.359	19.68	1.57	17.03
W_4 : Pendimethalin	1.576	0.126	1.361	21.71	1.74	18.76
W_5 : Atrazine+one HW at 25 DAS	1.530	0.124	1.347	11.83	0.96	10.42
W_6 : Pendimethalin+one HW at 25 DAS	1.532	0.124	1.354	11.53	1.03	11.22
SEm+	0.052	0.004	0.038	0.82	0.06	0.80
CD (p=0.05)	NS	NS	NS	2.37	0.16	2.30
Residue management						
R_1 : Control	1.556	0.125	1.354	66.38	5.34	57.58
R_2 : Mustard residue @ 5 t/ha	1.569	0.126	1.360	11.13	0.89	9.62
R_3 : Brown manuring	1.575	0.128	1.374	8.96	0.78	8.30
SEm+	0.037	0.003	0.027	0.58	0.04	0.57
CD (P=0.05)	NS	NS	NS	1.68	0.11	1.63
Interaction effect	NS	NS	NS	NS	NS	NS
CV (%)	9.918	9.36	8.26	8.58	7.11	9.56

Corroborative finding were also reported by Saxena (2008), Yadav *et al.* (2014) and Seema *et al.* (2015).

Effect on nutrients concentration and their depletion by weed

Data presented in Table 4 indicated that mAJORN, P and K concentration in weeds was not influenced significantly due to weed control measures as well as residue management practices. But minimum nutrient concentration in weeds recorded in both atrazine + one hand weeding at 25 DAS and pendimethalin + one hand weeding at 25 DAS as weed control. Whereas, among residue management practices, brown manuring recorded higher nutrient concentration in weeds. Among the weed control measures treatment pendimethalin + one hand weeding at 25 DAS reduced the maximum N depletion by weeds to the tune of 86.60% at harvest as compared to control whereas it was remained at par with atrazine + one hand weeding at 25 DAS. However, maximum P and K depletion by weeds treatment atrazine + one hand weeding at 25 DAS reduced the to the tune of 86.15 and 86.60% at harvest as compared to control, respectively. Application of atrazine and pendimethalin were being at par with each other and superior to control. These results are in accordance with those reported by Baldev *et al.* (2004). The practice of brown manuring significantly reduced N, P and K depletion by weeds over control to the extent of 86.50, 85.39 and 85.59 % which was at par with application of mustard straw, respectively.

Table 5. Correlation coefficients and linear regression equations showing relationship between grain yield (kg/ha) and independent variables (X). * Significant at 5 % level of significance ** Significant at 1 % level of significance.

Sl.No.	Independent variables (X)	Correlation coefficients (r)	Regression equations ($Y = a + b_{yx} X$)
1.	Weed dry matter at harvest (kg/ha)	-0.770**	$Y = 18.764 - 0.0081 X_1$
2.	N depletion by weeds at harvest (kg/ha)	-0.770**	$Y = 18.739 - 0.051 X_2$
3.	P depletion by weeds at harvest (kg/ha)	-0.766**	$Y = 18.744 - 0.637 X_3$
4.	K depletion by weeds at harvest (kg/ha)	-0.767**	$Y = 18.750 - 0.059 X_4$

The significantly higher nutrient depletion recorded under control than rest of the treatments. It might be due to lower weed infestation and weed dry matter production. These findings are in conformity with those reported by Chongtham *et al*. (2015).

Correlation and regression

Correlation coefficients and regression equations were worked out to study the relationship of grain yield with weed dry matter and nutrient depletion by weeds which are summarized in Table 5. The results of correlation coefficients indicated that grain yield of pearl millet was significantly and negatively correlated with weed dry matter (r =-0.770) and N, P and K depletion by weeds (r = -0.770, -0.766 and -0.767, respectively) at harvest Linear relationship appeared to exist between grain yield and independent variables. The regression equations showed that every unit increase in weed dry matter and N, P and K depletion by weeds at harvest stage decreased the grain yield of pearl millet by 0.0081, 0.051, 0.637 and 0.059 q/ha, respectively. The results obtained are in close conformity with the findings of Virkar *et al.* (2007), Shete *et al*. (2009) and Mathukia *et al*. (2015).

REFERENCES

Anitha S, Mathew J, Abraham CT (2012) Concurrent growing of green manure with wet-seeded rice for cost-effective weed management. Ind J of Weed Sci 44 (1): 34–37.

Baldev Ram, Chaudhary GR Jat AS (2004) Nutrient depletion by weeds, weed-control efficiency and productivity of pearl millet (*Pennisetum glaucum*) as influenced by intercropping systems and integrated weed management. Ind J Agricultu Sci 74(10): 534-538.

Baldev Ram, Chaudhary GR, Jat AS, Jat ML (2005) Effect of integrated weed management and intercropping systems on growth and yield of pearl millet (*Pennisetum glaucum*). *Ind J Agron* 5 (3): 210-213.

Banga RS, Yadav A, Malik RK, Pahwa SK, Malik RS (2000) Evaluation of tank mixture of acetachlore and atrazine or 2, 4-D Na against weeds in pearl millet. *Ind J Weed Sci* 32 (3&4): 194-198.

Chongtham SK, Singh RP, Singh RK, Lhungdim J, Imtiyaj Ahmad (2015) Effect of crop establishment methods and weed management practices on weeds, growth and yield of direct-seeded rice. *Res on Crops* 16 (1): 21-26.

Gomez KA, Gomez AA (1984) Statistical Procedures for Agricultural Research (2nd ed.). John Wiley and Sons, New York, pp 680.

Johanson GA, Hoversted TR, Green wald RE (1998) Integrated weed management using narrow corn row spacing, herbicides and cultivation. *Agron J* 90 (1): 40-46.

Kaur A, Singh VP (2006) Weed dynamics as influenced by planting methods, mulching and weed control in rainfed hybrid pearl millet (*Pennisetum glaucam*). *Ind J Weed Sci* 38 (1&2): 135-136.

Kiroriwal A, Yadav RS, Kumawa A (2012) Weed management in pearl millet based intercropping system. *Ind J Weed Sci* 44 (3): 200–203.

Maity SK, Mukherjee PK (2009) Effect of Brown Manuring on Grain Yield and Partial Factor Productivity of Nutrients in Dry Direct Seeded Summer Rice (*Oryza sativa)* under Terai Agro-ecological Region of West Bengal. *J Crop Weed* 5 (2) : 31-35.

Mathukia RK, Mathukia, PR, Polara AM (2015) Intercropping and weed management in pearl millet (*Pennisetum glaucum*) under rainfed condition. *Agric Sci Dig* 35(2):138-141.

Munde SD, Aghav VD, Pagar RD, Patel JC (2012) Effect of herbicides on weeds and yield of rainy season pearl millet (*Pennisetum glaucum* (L.) R. Br. emend. and Stuntz). *Crop Res.* 44 (3): 288-291.

Nath CP, Das TK, Rana KS (2016) Effects of herbicides and tillage practices on weeds and summer mungbean in wheat-mungbean cropping sequence. *Ind J Agricult Sci* 86: 860-864.

Ramachandran A, Veeramani, Prema P (2012) Effect of brown manuring on weed growth, yield and economics of irrigated maize. *Ind J Weed Sci* 44 (3): 204–206.

Regar PL, Rao SS, Vyas SP (2009) Crop residue management for sustainable production of Indian mustard *(Brassica juncea)* in arid and semi arid region. *Ind J Soil Conserv* 37(2): 118-122.

Seema, Pandey PC, Singh DK, Thoithoi M (2015) Effect of Weed Management Practices along with Brown Manuring on Yield of Aerobic Rice and Weed Control Efficiency at Different Nitrogen Levels. *Environ Ecol* 33(2A): 819-822.

Sharma OI, Jain NK (2003) Integrated weed management in pearl millet. *Ind J Weed Sc*i 35 (1&2): 134-135.

Shete BT, Dhage VJ, Patil, JB, Barve UV (2009) .Effect of integrated weed management in pearl millet-pigeonpea. *Ann Pl Physio*l 23(1):66-68.

Virkar KM, Patil HM, Khairnar AV,Wani AG (2007) Integrated weed management in pearl millet - pigeon pea intercropping system. *J Farm Syst Res & Develop* 13(2): 245-247.