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A COMPARATIVE STUDY OF WEED MANAGEMENT PRACTICES AND THEIR EFFECTS ON GROWTH AND YIELD OF WHEAT (*TRITICUM AESTIVUM* L.)

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ABSTRACT

The current study was conducted in *Rabi* Season of 2023-24 at Crop Research Farm, Department of Agronomy, Tantia University, Sri Ganganagar, Rajasthan, India. A combination of 12 treatments used with three replications in (RBD) Randomized Block Design to study the effect of weed management practices on growth, yield attributes and weed index in wheat (DBW303). Results indicates significant improvement in crop growth characters like plant height, number of tillers m^{-2}, leaf area index and crop growth rate were obtained due to application of weed control treatments. Pendimethalin applied @ 1 kg ha^{-1} + one HW proved its superiority over all other weed control treatments at all the crop growth stages. Yield attributes such as productive panicles m^{-2}, panicle length, number of grains $panicle^{-1}$ and 1000 grain weight were significantly affected by weed control treatments. Pendimethalin + one HW had the remarkable effect in increasing the yield components. It was followed by Metsulfuron + 2, 4-D EE, two hand weeding, 2, 4-D @ 0.5 kg ha, pendimethalin + 2, 4-D EE @ 0.5 kg ha, which were found better than the Pendimethalin @ 1 kg ha^{-1} and Metsulfuron @ 0.02 kg ha alone. All the weed control treatments increased significantly the grain and straw yield over the unwedded control. Pre-emergence application of pendimethalin @ 1 kg ha^{-1} + one hand weeding produced the highest grain (5784 kg ha^{-1}) and straw (7734 kg ha^{-1}). Maximum reduction in grain yield to the extent of 38.33 % was found in unweeded control.

***Key words*:** Wheat, Pendimethalin, Metsulfuron, grain and straw yield

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important crops among the cereals. It belongs to family Poaceae and originated from the Middle-East region of Asia. Wheat has a global significance as it is staple food for millions of people and supplies 20% of the food calories for world's growing population. In India, it is the 2nd staple food crop next to rice. It is an important winter cereal crop contributing about 32% of the total food grain production in India. It is the cheapest source and supplier of the calories and protein for healthy diet (Heyne, 1987). Wheat straw is also major source of fodder for the animal population of country. Wheat grain contains starch (60-90%), protein (11-16.5%), fat (1.5-2%), inorganic ions (1.2-2%), vitamins B complex and E (Rueda-Ayala *et al.*, 2011). The wheat grain contains gluten protein which enables leavened dough to rise by forming minute gas cells and this property enables bakers to produce light breads (Singh *et al.*, 2017).

In India, wheat stands second position in area and production, but first in productivity amongst all the cereals with acreage and production of 31.40 mha and 110.55 mt, respectively (Ministry of Agriculture & Farmers Welfare, 2023-24). Major wheat growing States of the country are U.P., Madhya Pradesh, Punjab, Haryana, Rajasthan, Maharashtra and Gujarat. Wheat (*Triticum* spp.) is one of the most important grain crops which is grown in approximately 225 million hectares worldwide, about half of which is in developing countries (Pisal and Sagarka, 2013). Currently, the wheat production of the

Table 1: A combination of 12 treatments used under this experimentation.

Treatments	Name of herbicide	Concentration	Formulation dose	Time of Doses (DAS)
T1	Pendimethalin	30 EC	1.0 Kg ha^{-1}	1
T2	Metribuzin	70 WP	0.3 kg ha^{-1}	25
T3	Metsulfuron	10 EC	0.02 kg ha^{-1}	25
T4	Pendimethalin + one hand -weeding	30 EC	1.0 kg ha^{-1}	25
T5	Pendimethalin + 2,4-D EE	30 EC+38 EC	1.0 kg ha^{-1} +0.5 kg ha^{-1}	25
T6	Metribuzin + one hand -weeding	70 WP	0.3 kg ha^{-1}	25
T7	Metribuzin +2,4-D EE	70 WP+38 EC	0.3 kg ha^{-1}+0.5 kg ha^{-1}	25
T8	Pendimethalin+ Metsulfuron	30 EC+10 EC	1.0 kg ha^{-1} + 0.02 kg ha^{-1}	25
T9	Metribuzin+ Metsulfuron	70 WP+10 EC	0.3 kg ha^{-1} + 0.02 kg ha^{-1}	25
T10	2,4-D EE	38 EC	0.5 kg ha^{-1}	25
T11	Two hand weeding at 25 and 45 DAS	-	-	25 + 45
T12	Unweeded check	-	-	-

country is 110.55 mt and about 140 mt of wheat will be required to fulfil the demand by 2050 (Anonymous, 2022-23).

Due to complexity and diversity of weed flora, more than one herbicide are required either in sequence or as mixture for weed management. Many sulphonyl urea herbicides have widely been used in wheat due to their low application rate and less persistency in environment. Sulfonylurea herbicides are also considered as the substitute for existing herbicides because of their capability to manage grassy as well as broad-leaved weeds, high potency, and low mammalian toxicity (Singh *et al.*, 2005). Amongst these, metsulfuron-methyl and sulfosulfuron, the newly emerging herbicides of sulfonylurea group are of great importance as these herbicides give excellent control of weeds in wheat by inhibiting acetolactate synthase (ALS) mechanism. Premix application of sulfosulfuron and metsulfuron methyl obtained the highest weed control efficiency along with highest yield increase in wheat. A postemergence contact herbicide carfentrazone applied @ 20-25 g ha^{-1} provided tremendous control of broad leaves weeds such as Convolvulus arvensis and Malva parviflora in wheat (Punia *et al.*, 2005).

Integrated weed management (IWM) involves deployment of different methods of weed prevention and control in right proportion and at appropriate time against the target weeds (Gupta *et al.*, 2008). Majority of the research in India on IWM was herbicide-based. However, majority of the farmers have not been benefitted by herbicides in India. The concept of IWM is not new and limited number of studies have been reported on non-chemical methods of IWM. Pedimethalin @ 1.0 kg ha^{-1} as per emergence (PE) plus one hand weeding at 45 DAS exhibited greater growth, yield and NPK uptake by the wheat crop in comparison to metsulfuron-methyl, Clodinafop, 2-4 D amine salt and unwedded control (Pisal and Sagarka, 2013). The challenge for weed scientists is to develop innovative, effective, economical and environmentally safe IWM systems that can be integrated into current and future cropping systems to bring a more diverse and integrated approach to weed management. Thus, IWM practices should be decided on site and time specific basis and it should be designed as a long-term strategy by considering the weed management a broader ecological and management. The experiment was conducted to study the effect of weed management practices on growth, yield attributes and weed index in wheat.

Materials and Method

The experiment was conducted in *Rabi* Season of 2023-24 at Crop Research Farm, Department of Agronomy, Tantia University, Sri Ganganagar, Rajasthan, India located at 28.4° N latitude, 72.2° E longitude and 178 m above mean sea level. DBW303 (Karan Vaishnavi), a high yielding bread wheat variety used in this study was developed by ICAR- Indian Institute of Wheat & Barley Research, Karnal. Several growths and yield related traits study where, growth attributes *viz.*, plant height, number of tillers per running m^{-2}, leaf area index (LAI), Dry matter accumulation, crop growth rate (CGR). Yield attributes *viz.*, Spike length, Number of grains per spike, Grain weight per spike, Test weight, Grain and straw yield, Harvest index were studied. A combination of 12 treatments used with three replications in (RBD) Randomized Block Design tabulated in Table 1.

Statistical analysis

Experimental data were processed in Microsoft Excel-2019 and analyzed with the help of analysis of variance (ANOVA) technique for Randomized Block

Table 2: Effects of weed management practices on plant height (cm), number of tillers m^{-2}, leaf area index and crop growth rate.

Treatments	Name of Herbicide	PH(90 DAS)	NTM(75 DAS)	LAI(75 DAS)	CGR(90 DAS)
T1	Pendimethalin	81.46	293	1.16	2.87
T2	Metribuzin	83.78	278	1.78	2.70
T3	Metsulfuron	92.33	183	1.19	3.71
T4	Pendimethalin + one hand -weeding	97.56	205	0.72	3.41
T5	Pendimethalin + 2,4-D EE	92.23	198	1.17	3.80
T6	Metribuzin + one hand -weeding	92.47	212	1.09	2.67
T7	Metribuzin +2,4-D EE	93.46	182	1.10	3.25
T8	Pendimethalin+ Metsulfuron	93.57	282	1.07	2.67
T9	Metribuzin+ Metsulfuron	94.44	265	1.07	2.33
T10	2,4-DEE	96.01	199	1.11	2.83
T11	Two hand weeding at 25 and 45DAS	93.75	267	1.09	2.61
T12	Unweeded check	92.14	18	0.96	2.44
SE(m)±		**3**	**9.0**	**0.13**	**1.72**
CD (P = 0.05)		**8**	**26.9**	**0.39**	**NS**

Design (RBD) (Gomez and Gomez, 1984). The significance of the treatments was tested using F test at 5% level of significance ($P \leq 0.05$) and means were compared using the critical difference (CD) test at $\alpha \leq 0.05$.

Results and Discussion

Effects of weed management practices on growth traits of wheat

Plant Height:

The plant height was increased with the advancement of crop age. The taller plants height (77.10 cm) was observed with application of same Pendamethelin + one Hand weeding (Table 2). Reduction in plant height in unweeded check is because of heavy weed growth compete with the crop plants to the maximum extent and crop growth might have at sub-optimal rate thus curtailed vertical crop growth. Weed control treatments enhanced the supply of all factors of crop growth and increased plant height. Taller plants were produced with application of Metsulfuron @ 0.02 kg ha^{-1} followed by Metsulfuron + 2, 4-D EE @ 0.5kg ha^{-1} at 25 DAS. Increase in plant height with the Metsulfuron @ 0.02 kg/ha treatment agrees with the findings of Jat *et al*., (2009).

Number of tillers m^{-2}:

Tillering behaviour is an important measure of crop growth and yield of wheat. Highest number of tillers m^{-2} was recorded with application of pendimethalin @ 1 kg ha^{-1}, which was at par with treatment Metsulfuron @ 0.02 kg ha^{-1} Metribuzin + Metsulfuron (Table 2). Unrestricted weed growth reduced the tillering in wheat at all the growth stages of the crop. Application of 2,4-D, metribuzin, metribuzin + metsulfuron and metsufuron + 2, 4-D EE @ 0.5kg ha^{-1} at 25 DAS significantly increased the tillering in wheat over unweeded control. Pendimethalin @ 1 kg ha^{-1} + two hand weeding increased the number of tillers m^{-2}. Better tillering in the above treatments can be ascribed for greater weed control efficiency and reduction in weed competition.

Leaf area index:

Leaf area index is the yardstick for measuring the photosynthetic efficiency of crops. Weed control treatments had the positive effect on the LAI during the crop development stage. Maximum LAI was observed with application Pendimethalin + one HW at 25 DAS, which remained at par with pendimethalin alone and two hands weeding (Table 2). It might be ascribed to rate of early increase in LAI was dependent on light and temperature conditions. It is an accent parameter with a positive correlation on wheat yield. Due to least weed competition and better WCE resulted in profuse crop growth. In unweeded control the LAI values were lowest because severe weed growth exerted adverse effect on crop.

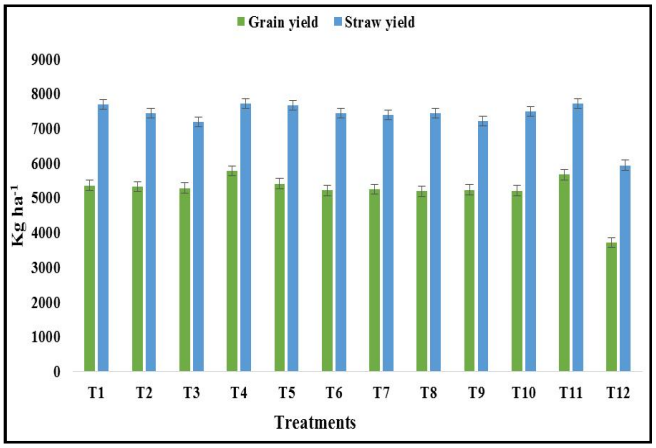

Fig. 1: Effects of weed management practices on grain yield and straw yield.

Table 3: Effects of weed management practices on grain yield, straw yield, harvest Index and weed Index.

Treatments	Name of Herbicide	GY(kg ha^{-1})	SY(kg ha^{-1})	HI (%)	WI (%)
T1	Pendimethalin	5365	7690	41.79	15.05
T2	Metribuzin	5333	7434	45.94	16.20
T3	Metsulfuron	5284	7206	45. 87	17.96
T4	Pendimethalin + one hand -weeding	5784	7734	42.45	13.21
T5	Pendimethalin + 2,4-D EE	5415	7660	40.59	13.25
T6	Metribuzin + one hand -weeding	5219	7448	43.55	20.29
T7	Metribuzin +2,4-D EE	5255	7398	43.46	19.00
T8	Pendimethalin+ Metsulfuron	5200	7443	42.38	20.98
T9	Metribuzin+ Metsulfuron	5241	7231	45.11	19.50
T10	2,4-DEE	5217	7485	43.15	20.37
T11	Two hand weeding at 25 and 45DAS	5677	7720	44.60	3.84
T12	Unweeded check	3717	5947	41.86	38.33
SE(m)±		**280.82**	**302.66**	**1.85**	**1.11**
CD (P = 0.05)		**530.78**	**608.89**	**5.44**	**3.48**

Crop growth rate:

Dry matter production of crop is dependent upon genetic potential and a set of environmental and management factor. The data on CGR presented in Table 2 indicated that CGR between 60-75and 90 DAS was fund non- significant. The CGR showed that weed management practices positively influenced the CGR of wheat crop throughout the crop development. The unweeded plot recorded the lowest CGR. This is because severe weed competition reduced the plant height and number of tillers m^{-2} ultimately resulted in reduced photosynthate. Throughout the crop development stage, pre-emergence application of pendimethalin improved favourably the CGR.

Effects of weed management practices on yield and yield attributing traits of wheat

Grain and straw yield:

Data presented in Table 3 and illustrated in Fig. 1 showed that weed management practices caused significant variation in straw yield of wheat. Unrestricted growth of weed gave the lowest straw yield (5947 kg ha^{-1}). Significant increase in straw yield was observed with pendimethalin + one HW (7734 kg ha^{-1}). Data indicated that weed control treatments significantly augmented both the grain and straw yield of wheat. Pre- emergence application of pendimethalin @ 1 kg ha^{-1} + two HW produced the maximum grain and straw yield. Hand weeding treatment did not differ significantly from the pendimethalin. Higher yields were attributed due to increase in growth and yield parameters thus favoured accumulation of more sink which ultimately increased the yield. it is an agreement with findings of Kaur *et al*., (2007) and Jat *et al*., (2010). The use of pendimethalin controls the weeds at early stage of crop growth and maintains relatively low weed infestation till the harvest of crop and influenced the crop growth, more nutrient uptake and subsequently increases the grain yield. It

Table 4: Effects of weed management practices on yield attributing traits of wheat.

Treatments	Name of Herbicide	NS (m^2)	SL (cm)	NGS	TW (g)
T1	Pendimethalin	323.33	10.73	42.67	42.51
T2	Metribuzin	285.01	10.00	39.67	38.90
T3	Metsulfuron	288.01	10.23	43.33	39.91
T4	Pendimethalin + one hand -weeding	295.67	10.83	42.00	39.79
T5	Pendimethalin + 2,4-D EE	313.67	11.60	43.00	36.88
T6	Metribuzin + one hand -weeding	335.12	11.40	44.67	41.84
T7	Metribuzin +2,4-D EE	315.33	11.37	46.67	38.86
T8	Pendimethalin+ Metsulfuron	323.12	9.23	41.67	42.17
T9	Metribuzin+ Metsulfuron	315.10	11.17	38.67	40.17
T10	2,4-DEE	309.67	11.17	40.33	39.39
T11	Two hand weeding at 25 and 45DAS	294.67	11.47	42.33	40.51
T12	Unweeded check	278.10	8.13	36.20	23.39
SE(m)±		**5.52**	**0.63**	**1.55**	**1.74**
CD (P = 0.05)		**16.19**	**1.85**	**4.54**	**5.12**

agrees with the findings of Jat *et al*., (2010).

Harvest index:

The data on harvest index was presented in Table 3. The perusal of data indicated that the maximum harvest index was observed with application metribuzin @ 0.3 kg ha^{-1} of (45.94%). The harvest index of all treatments varied with the range of 40.59 to 45.94 per cent.

Weed index:

Weed index computed based on maximum grain yield recorded with application of pendimethalin + one HW and presented in Table 3. It indicated that maximum degree of weed competition occurred in unweeded control resulted in yield loss to the extent of 38.3%. Minimum yield reduction was observed with two hand weeding at 25 & 45 DAS (3.07%) followed by pendimethalin @1.0 kg ha^{-1} + 2, 4-D EE @ 0.5 kg ha^{-1} (13.25%). Data revealed that maximum reduction in yield up to 38.33% was observed under no weeding situation. Hand weeding treatment registered the minimum yield reduction value of 3.84%. It is in line with respect to the findings of many workers (Kumar *et al*., (2011); Singh *et al.,* (2008) and Chopra *et al*., (2008).

Effects of weed management practices on yield attributing traits of wheat

Number of spike m^{-2}:

It was revealed from the Table 4 that significantly the highest number of productive spike m^{-2} was recorded with metsulfuron + one HW at 25 DAS, which was at par the treatments with pendimethalin @1.0 kg ha^{-1} and pendimethalin + metsulfuron. The next best result was obtained with pendimethalin @1.0 kg ha^{-1} (323.33), pendimethalin + metsulfuron (323.12), metsulfuron + 2, 4-D EE @ 0.5kg ha^{-1} at 25 DAS (315.33m2), metribuzin + metsulfuron (315), pendimethalin + 2, 4-D EE@0.5 kg ha^{-1} (313.67) and 2, 4-D @0.5 kg ha^{-1} at 25 DAS (309.67). Weedy check plot recorded the minimum of 278 panicles m^{-2}.

Spike length

An examination of data presented in Table 4 pointed out that longest panicle was observed by pendimethalin+2, 4-D EE @ 0.5 kg ha^{-1} (11.60 cm) followed by metsulfuron + one HW at 25 DAS (11.40cm), metsulfuron + 2, 4-D EE @ 0.5kg ha^{-1} at 25 DAS (11.37cm), Pendimethalin + one HW (10.83cm), pendimethalin @1.0 kg ha^{-1} (10.73 cm), metsulfuron @ 0.02 kg ha^{-1} (10.23 cm) and metribuzin @ 0.3 kg ha^{-1} (10 cm), which did not differ significantly from other herbicidal treatments. Weedy check produced the shortest panicle (8.13 cm).

Number of grains $spike^{-1}$

Experimental results on number of filled grains $spike^{-1}$ are presented in Table 4. It indicated that herbicides and manual weeding treatments were significantly better than weedy check. The maximum number of filled grains panicle was recorded in metsulfuron +2, 4-D EE @ 0.5 which remained at par with Treatments Pendimethalin @1.0 kg ha^{-1}, Metsulfuron @ 0.02 kg ha^{-1}, Pendimethalin + 2, 4-D EE @ 0.5 kg ha^{-1}, Metsulfuron + One HW at 25 DAS Two hand weeding at 25 & 45 DAS. Unweeded control plot recorded the lowest value (36.20).

Test weight

The data on 1000 grain weight presented in Table 4 revealed that weed control treatments significantly influenced the test weight. The maximum test weight was with application of pendimethalin @1.0 kg ha^{-1} (42.51g) followed by pendimethalin+ metsulfuron (42.17g), metsulfuron + one HW at 25 DAS (41.84 g), metribuzin + metsulfuron (40.17g) and two hand weeding at 25 & 45 DAS (40.51g) which were found at par with each other. The unweeded control recorded the lowest test weight (23.39g).

The magnitude of yield attributes like productive tillers m^{-2}, spike length, number of grains $spike^{-1}$ and test weight contributes directly in increase in grain yield. Yield attributes were significantly influenced by weed control treatments. Application of Metsulfuron + one HW at 25 DAS promoted all the yield components in wheat. Pendimethalin @ 1.0 kg/ha gave the next best result. The improvement in yield parameters due to application of Metsulfuron + one HW at 25 DAS & pendimethalin is attributed to reduction in competitiveness of weeds with the crop for the desired inputs like nutrient, moisture, light and space which ultimately provided better environment for crop growth and development. It is in conformity with the findings of Kanojia & Nepalia, (2006) and Jat *et al*., (2009).

Conclusion

Based on the findings of the present investigation, it may conclude that the wheat performed well with application of Pendimethalin@ 1 kg ha^{-1} + one hand weeding in terms of better growth, yield attributes and yield of wheat. Based on the above findings it can recommended that wheat grown with application of Pendimethalin@ 1 kg ha^{-1} + one hand weeding can successfully sustain the productivity of wheat. The use of pendimethalin controls the weeds at early stage of crop growth and maintains relatively low weed infestation till the harvest of crop and influenced the crop growth, more nutrient uptake and subsequently increases the grain yield. The magnitude of yield attributes like productive tillers m^{-2}, spike length, number of grains $spike^{-1}$ and test

weight contributes directly in increase in grain yield. Yield attributes were significantly influenced by weed control treatments.

References

Anonymous (2022-23). Ministry of Agriculture & Farmers Welfare, 2023-24.

Chopra, N.J., Mishra M., Kewat L. and Jain V. (2008). Effect of tillage and herbicides on weedseed bank dynamics in wheat (*Triticum aestivum*) under transplanted rice-wheat system. *Indian Journal of Weed Science*, **38(4)**, 112-114.

Gomez, K.A. and Gomez A.A. (1984). Statistical procedures for agricultural research. John wiley & sons.

Gupta, H.S., Gopinath K and Pandey A.K. (2008). integrated weed management in wheat (*Triticum aestivum*) *Indian Journal of Weed Science*, **25(3)**, 112-116.

Heyne, E.G. (1987). Wheat and wheat improvement (Vol. 2). Madison, WI: American Society of Agronomy, Crop Science Society of America, Soil Science Society of America.

Jat, G.R., Chhokar R.S., Sharma R.K., Pundir A.K. and Gathala M.K. (2010). Effect of tillage and herbicides on weeds and productivity of wheat under rice-wheat growing system. *Crop Protection*, **26(3)**, 1689-1696.

Jat, R.K., Punia S.S. and Malik R.K. (2009). Efficacy of herbicide mixtures and sequential applications against different weeds in wheat (*Triticum aestivum* L.). *Indian Journal of Weed Science*, **39(1&2)**, 132-134.

Kanojia,Y. and Nepalia V. (2006). Effect of chemical weed control on nutrient uptake by wheat and associated weeds. *Agricultural Science Digest*, **26(2)**, 141-143.

Kaur, M., Walia U.S. and Sindhu V.K. (2007). Bioefficacy of herbicides for the control of isoproturon resistant *Phalaris minor* Retz. and their residual effects on succeeding crops. *Indian Journal of Weed Science*, **39(1)**, 126-128.

Kumar, S., Angiras N.N. and Rana, S.S. (2011). Bio-efficacy of clodinafoppropargyl+ metsulfuron methyl against complex weed flora in wheat. *Indian Journal of Weed Science*, **43(3&4)**, 195-198.

Pisal, R.R. and Sagarka R.K. (2013). Integrated weed management in wheat with new molecules (*Triticum aestivum* L). *India Journal of Weed Science*, **45(1)**, 25-28.

Punia, S.S. and Varma A.K. (2005). Effect of isoproturon tank mix with metsulfuron and 2, 4-D on weeds and yield on wheat. *Indian Journal of Agronomy*, **49(2)**, 114-115.

Rueda Ayala, V.P., Rasmussen J., Gerhards R. and Fournaise N.E. (2011). The influence of post emergence weed harrowing on selectivity, crop recovery and crop yield in different growth stages of winter wheat. *Weed Research*, **51(5)**, 478-488.

Singh, D.K., Rathi A.S., Kumar V. and Singh V.P. (2005). Integrated weed management in irrigated wheat. *Progressive Agriculture*, **8(2)**, 74-75.

Singh, R.P., Verma S.K., Kumar S. and Lakara K. (2017). Impact of tillage and herbicides on the dynamics of broad leaf weeds in wheat (*Triticum aestivum* L.). *International Journal of Agriculture, Environment and Biotechnology*, **10(6)**, 643-652.

Singh, V.P., Mishra J.S. and Yaduraju N.T. (2008). Effect of tillage practices and herbicides on weed dynamics and yield of wheat (*Triticum aestivum*) under transplanted rice (*Oryza sativa*)-wheat system in vertisols. *Indian Journal of Agronomy*, **50(32)**, 106-109.