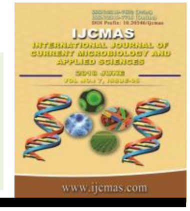
Int.J.Curr.Microbiol.App.Sci (2018) *7*(6): 3573-3581

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 06 (2018)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2018.706.420

Influence of Varieties and Herbicide Mixtures on Wheat Based Cropping System in Relation to Phytotoxicity and Residual Soil Nutrients

Sarita Rani[1]*, Suresh Kumar[1], V.S. Hooda[1], and Jagdish Parshad[2]

[1]Department of Agronomy, [2]Department of Microbiology,
CCS Haryana Agricultural University, Hisar- (125004), Haryana, India
**Corresponding author*

Keywords

Wheat, Metribuzin, Clodinafop, Pinoxaden, Fenoxaprop, Phytotoxicity, Soil nutrients

Article Info

Accepted:
25 May 2018
Available Online:
10 June 2018

A B S T R A C T

An experiment was conducted at Research Farm of CCS Haryana Agricultural University, Hisar Haryana (India) during 2014-15 and 2015-16, to study the influence of varieties and herbicide mixtures on wheat in relation to phytotoxicity and residual soil nutrients. The treatments consisting of five varieties of wheat *viz*., WH 1105, HD 2967, DPW 621-50, WH 1124 and DBW 17 in main plots and six weed management practices *i.e.* metribuzin (210 g ha^{-1}), metribuzin+fenoxaprop (150+100 g ha^{-1}), metribuzin+pinoxaden (150+40 g ha^{-1}), metribuzin+clodinafop (150+45 g ha^{-1}), weed free and weedy check in sub-plots in split plot design with three replications. All the herbicide treatments were applied at 35 days after sowing (DAS) of wheat. No phytotoxic effect of any of the herbicidal treatments was observed on crop during both years except appearance of some spots on leaves of wheat variety HD 2967 after spray in plots treated with metribuzin alone and tank mix application of metribuzin + fenoxaprop, which didn't show any effect on yield of the crop. There was no significant effect of weed management practices on residual organic carbon (%), available P_2O_5, and K_2O during both the years, however, available soil N after crop harvest was significantly lower in weed free plots as compared to all the herbicides treated and weed free plots during both the years.

Introduction

Wheat (*Triticum aestivum* L) is the second most important staple food crop cultivated in the world with 223.66 m ha area of cultivation, 735.26 m tonnes production with average productivity of 3290 kg/ha during 2015-16. It stands third after maize and rice in the world (USDA, 2017). It is the basic foodstuff of the developing countries and major commodity in the world food trade (Hussain *et. al*., 2012). India is second leading country in wheat production (86.53 m tones) from an area of 31.47 m ha with an average productivity of 2750 kg/ha (USDA, 2017). Out of total 18 species of the genus *Triticum*, 12 are cultivated species and in India, 3 species of wheat *Triticum aestivum*, *Triticum* *durum* and *Triticum dicoccum* are cultivated with 87, 12 and 1 percent contribution, respectively. ln India, Uttar Pradesh ranks first in terms of area as well as production and Haryana ranks second after Punjab in productivity (4.4 t/ha) with 2.58 mha area and 11.35 mt production of wheat (Anonymous, 2018). The increasing demands of rising population require not only sustaining wheat production but also further increasing it with high potential. The best way to increase the wheat production is to reduce the agricultural losses with increasing production. In India, among the annual agricultural losses, weeds account for 45 per cent followed by, insects 30 per cent, diseases 20 per cent and other 5 per cent in wheat (Kler *et. al*., 2002). So, weeds are a major problem to crop production and are accountable for maximum losses caused by all the pests. Weed competition is one of the most important constraints in crop production as weeds compete with crop plants for moisture, nutrients, light and space, thereby depriving the crop of vital inputs. (Chhokar *et. al*., 2012). Up to 51% of reduction in grain yield in weedy check plot compared to treated plots was observed in wheat (Singh *et. al.* 2015). Among the weed control measures, herbicidal control plays an important role in close row crops, where manual or mechanical weeding is not feasible (Yaduraju and Mishra, 2002). Mimicry grassy weeds cannot be weeded out manually or mechanically in wheat. Therefore, herbicidal control is more effective against grassy and broadleaf weeds in wheat. But continuous use of herbicide over several years certainly leads to elimination of sensitive weed species but leave out tolerant species resulting in gradual buildup of their population on account of herbicide resistance i.e. *Phalaris minor* against isoproturon (Malik and Singh, 1995). Due to the large scale failure of isoproturon, danger of development of rapid resistance and cross-resistance against alternate herbicides due to their continuous use, non-adoption of herbicides like pendimethalin by farmers because of its high cost and requirement for high moisture at the time of spray, phytotoxicity due to high doses of metribuzin and proportionate changes in weed flora in cereal crops necessitates using herbicide mixtures (Yadav *et. al.*, 2002; Sharma *et. al*., 2002; Yadav and Malik, 2005; Chhipa and Nepalia, 2015).

Crop cultivars possessing traits such as fast germination, quick growth, large leaf area and high biomass have a competitive advantage over weeds. Sowing such cultivars has been shown to suppress weeds in various crops (Sardana *et. al*., 2017). Competitive cultivars can reduce weed growth in the standing crop, curtail weed seed production, prevent future weed infestation and may serve as a low cost tool in weed management (Kumar *et. al*., 2013). Careful selections of a competitive crop/genotype can potentially suppress weed growth without sacrificing crop yield (Ramesh *et. al*., 2017). Cultivars of several crops including winter wheat differ considerably in their tolerance to metribuzin (Runyan *et. al*., 1982). Differential varietal sensitivity to fenoxaprop + metribuzin has been reported (Yadav *et. al*., 2012) and it is suggested to determine varietal sensitivity of fenoxaprop + metribuzin before use in field conditions (Yadav *et. al*., 2016). Reduction in wheat yield by 23 percent with application of metribuzin at 210 g $ha^{-1}$was reported when applied at 60 over 38 DAS (Singh *et. al.* 2011). Choudhary *et. al.* (2016) found lowest harvest index in metribuzin 200 g/ha as compared to all other herbicidal treatments, which was attributed to phytotoxic effect of metribuzin on wheat cultivar ‘PBW-343’. Keeping this in view present investigation was conducted to study the impact of wheat varieties and weed management practices in relation to herbicide phytotoxicity and residual soil nutrients.

Materials and Methods

An experiment was conducted during 2014-15 and 2015-16 at research farm, CCS Haryana Agricultural University, Hisar, Haryana (India) situated at 29°10' N latitude and 75°46' E longitude at an elevation of 215.2 m above mean sea level in a semiarid climate. The upper soil layer of the experimental field was sandy loam, low in OC (0.41%) and nitrogen (212 kg/ha), medium in P_2O_5 (16.6 kg/ha) and high in K_2O (408 kg/ha) with slightly alkaline in pH (8.3). The experiment was laid out in split plot design with three replications. The treatments consisting of five varieties of wheat *viz*. WH 1105, HD 2967, DPW 621-50, WH 1124 and DBW 17 in main plots and six weed management practices *i.e.* metribuzin (210 g ha^{-1}), metribuzin+fenoxaprop (150+100 g ha^{-1}), metribuzin+pinoxaden (150+40 g ha^{-1}), metribuzin+clodinafop (150+45 g ha^{-1}), weed free and weedy check in sub-plots. All the herbicide treatments were applied at 35 DAS of wheat, preparing herbicide combinations by tank-mixing and repeated manual weedings were practiced for maintaining the weed free plots. Fodder maize was planted after the harvest of wheat crop. The data on plant height of wheat and fodder maize, and grain yield of wheat were collected at different stages and statistically analyzed. Visual surveillance was undertaken to observe crop injury in wheat and maize. Soil analysis was done at the start and harvest of crop. The mean weekly weather data for the wheat-fodder maize cropping seasons 2014-15 and 2015-16 have been given in Fig. 1 and 2.

Results and Discussion

Herbicide phytotoxicity to wheat crop (0-10 scale)

Visual phytotoxicity (0-10 scale) recorded at 10 and 20 days after spraying indicated that there was no phytotoxic effect of any of the herbicidal treatments on crop during both years. However, some freckles/ spots appeared on leaves of wheat variety HD 2967 after spray in plots treated with metribuzin 210 g $ha^{-1}$and tank mix application of metribuzin + fenoxaprop 150 + 100 g ha^{-1}, which disappeared within 1-2 weeks, and had no effect on the crop (Table 1).

Plant height (cm)

At 120 DAS, maximum plant height was recorded in wheat variety HD 2967 (97.9 cm and 94.7 cm), which was statistically at par with all varieties except DBW 17 (83.4 cm and 79.7 cm) during 2014-15 and 2015-16, respectively (Table 2). WH 1105, DPW 621-50 were at par with HD 2967 in respect of plant height during both the years. Marked differences were recorded in the plant height with different weed management practices, maximum being with the weed free treatment (96.5 and 93.8 cm during 2014-15 and 2015-16, respectively). Among herbicidal treatments, combination of metribuzin with fenoxaprop produced tallest plants and was at par with weed free plots as well as combination of metribuzin with pinoxaden or clodinafop, but significantly taller than with metribuzin applied alone and weedy check during both the years. Weedy check plots resulted in significantly lower plant height of wheat as compared to all the herbicidal treatments during both years.

Plant height of succeeding fodder maize crop at 30 DAS was statistically similar to each other in all the plots of different preceding wheat varieties and did not show any significant difference during 2014-15 and 2015-16 (Table 2). There was no significant effect of different weed management practices applied in wheat on the plant height of succeeding fodder maize crop at 30 DAS during both the years.

Grain yield (kg/ha)

Wheat variety WH 1105 proved its superiority by producing grain yield (5855 and 5401 kg ha^{-1} during 2014-15 and 2015-16, respectively) being at par with HD 2967 and DPW 621-50, but statistically better than DBW 17 and WH 1124 (Table 2). WH 1124 showed the lowest grain yield and significantly lower than all the varieties during both the years. The weed management practices significantly influenced the wheat grain yield during both the years. The maximum grain yield was recorded in weed free plots (6284 and 5902 kg ha^{-1} during 2014-15 and 2015-16, respectively). Weedy check plots produced the minimum grain yield (4176 and 3781 kg ha^{-1} during 2014-15 and 2015-16, respectively) and was significantly lower than all the weed management practices. Among herbicidal treatments, metribuzin + fenoxaprop (150 + 100 g ha^{-1}) produced the maximum grain yield and it was statistically at par with weed free plots and remaining two combination treatments i.e., metribuzin + pinoxaden (150 + g ha^{-1}) and metribuzin + clodinafop (150 + 45 g ha^{-1}). Metribuzin (210 g ha^{-1}) produced significantly better grain yield as compared to weedy check, but it was inferior to combination treatments of metribuzin and other herbicides in terms of grain yield (Table 2).

Fig.1 Mean weekly weather data for wheat-fodder maize cropping seasons 2014-15

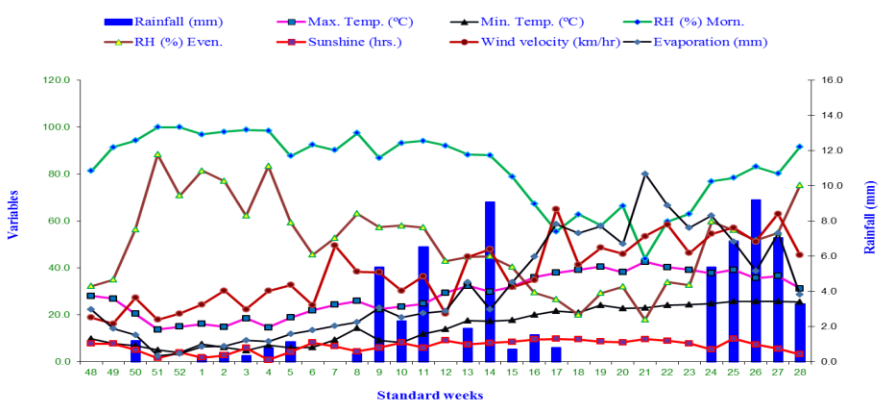


Fig.2 Mean weekly weather data for wheat-fodder maize cropping seasons 2015-16

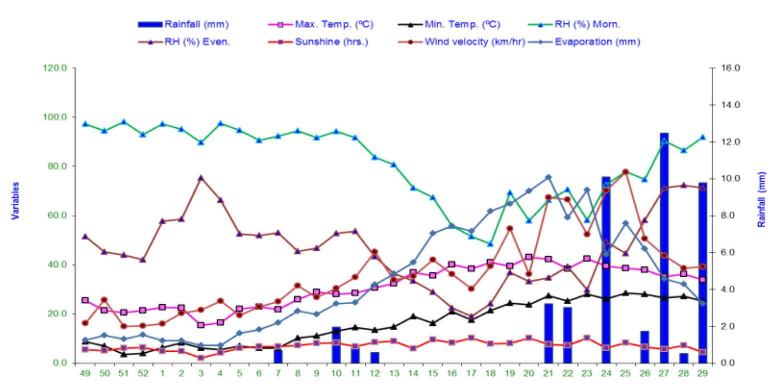


Table.1 Herbicide phytotoxicity to wheat crop (0-10 scale)

Variety	Treatments	2014-15		2015-16	
		10 DAT	20 DAT	10 DAT	20 DAT
WH 1105	MBZ 210 g ha^{-1}	0	0	0	0
WH 1105	MBZ + CDF (150 + 45) g ha^{-1}	0	0	0	0
WH 1105	MBZ + PDN (150 + 40) g ha^{-1}	0	0	0	0
WH 1105	MBZ + FNP (150 + 100) g ha^{-1}	0	0	0	0
WH 1105	Weed free	0	0	0	0
WH 1105	Weedy check	0	0	0	0
HD 2967	MBZ 210 g ha^{-1}	2	0	3	1
HD 2967	MBZ + CDF (150 + 45) g ha^{-1}	0	0	0	0
HD 2967	MBZ + PDN (150 + 40) g ha^{-1}	0	0	0	0
HD 2967	MBZ + FNP (150 + 100) g ha^{-1}	2	0	2	0
HD 2967	Weed free	0	0	0	0
HD 2967	Weedy check	0	0	0	0
DPW 621-50	MBZ 210 g ha^{-1}	0	0	0	0
DPW 621-50	MBZ + CDF (150 + 45) g ha^{-1}	0	0	0	0
DPW 621-50	MBZ + PDN (150 + 40) g ha^{-1}	0	0	0	0
DPW 621-50	MBZ + FNP (150 + 100) g ha^{-1}	0	0	0	0
DPW 621-50	Weed free	0	0	0	0
DPW 621-50	Weedy check	0	0	0	0
WH 1124	MBZ 210 g ha^{-1}	0	0	0	0
WH 1124	MBZ + CDF (150 + 45) g ha^{-1}	0	0	0	0
WH 1124	MBZ + PDN (150 + 40) g ha^{-1}	0	0	0	0
WH 1124	MBZ + FNP (150 + 100) g ha^{-1}	0	0	0	0
WH 1124	Weed free	0	0	0	0
WH 1124	Weedy check	0	0	0	0
DBW 17	MBZ 210 g ha^{-1}	0	0	0	0
DBW 17	MBZ + CDF (150 + 45) g ha^{-1}	0	0	0	0
DBW 17	MBZ + PDN (150 + 40) g ha^{-1}	0	0	0	0
DBW 17	MBZ + FNP (150 + 100) g ha^{-1}	0	0	0	0
DBW 17	Weed free	0	0	0	0
DBW 17	Weedy check	0	0	0	0

Abbreviations: MBZ, metribuzin; CDF, clodinafop; PDN, pinoxaden; FNP, fenoxaprop;

Table.2 Effect of different weed control treatments on plant height of wheat, grain yield 2014-15 and 2015-16

Treatments	Plant height wheat (cm) at 120 DAS		Plant height maize (cm) at 30 DAS		Wheat grain yield (kg ha^{-1})	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
A. Varieties						
WH 1105	95.9	94.3	65.5	64.3	5855	5401
HD 2967	97.9	94.7	64.2	64.1	5778	5297
DPW 621-50	96.6	93.0	67.1	67.5	5701	5222
WH 1124	95.2	92.3	66.6	67.3	5153	4782
DBW 17	83.4	79.7	64.2	65.3	5460	5048
SEm±	0.9	1.0	1.7	1.6	67	79
CD (5%)	2.8	3.0	NS	NS	223	261
B. Weed Management						
MBZ 210 g ha^{-1}	93.0	89.9	65.0	64.9	5153	4733
MBZ + CDF (150 + 45) g ha^{-1}	94.0	90.7	65.4	64.5	5926	5436
MBZ + PDN (150 + 40) g ha^{-1}	94.9	91.7	65.2	65.2	5967	5501
MBZ + FNP (150 + 100) g ha^{-1}	95.8	92.5	65.2	65.8	6032	5547
Weed free	96.5	93.8	66.4	66.4	6284	5902
Weedy check	88.5	86.2	65.9	67.2	4176	3781
SEm±	0.8	0.7	1.2	1.2	139	165
CD (5%)	2.3	2.1	NS	NS	397	469

Table.3 Effect of varieties and weed management practices in wheat on organic carbon and N, P, K availability in soil

Treatments	OC (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})
	2014-15			
A. Varieties				
WH 1105	0.35	205.6	14.6	402.0
HD 2967	0.36	207.3	15.1	397.0
DPW 621-50	0.37	209.3	15.6	406.0
WH 1124	0.41	212.6	16.5	410.0
DBW 17	0.40	212.0	16.2	408.0
SEm±	0.20	1.1	0.7	4.3
CD (5%)	NS	3.2	NS	NS
B. Weed Management				
MBZ 210 g ha^{-1}	0.38	211.4	16.3	409.0
MBZ + CDF (150 + 45) g ha^{-1}	0.37	209.8	15.9	407.0
MBZ + PDN (150 + 40) g ha^{-1}	0.37	208.9	15.3	404.0
MBZ + FNP (150 + 100) g ha^{-1}	0.39	208.1	15.1	402.0
Weed free	0.41	205.3	14.4	395.0
Weedy check	0.36	212.5	16.6	410.0
SEm±	0.20	2.1	0.8	4.3
CD (5%)	NS	6.0	NS	NS
	2015-16			
A. Varieties				
WH 1105	0.34	203.1	14.7	399.0
HD 2967	0.35	204.2	15.3	395.0
DPW 621-50	0.36	207.7	15.5	403.0
WH 1124	0.40	212.1	16.8	407.0
DBW 17	0.40	211.1	16.3	406.0
SEm±	0.20	1.4	0.8	4.2
CD (5%)	NS	4.2	NS	NS
B. Weed Management				
MBZ 210 g ha^{-1}	0.36	211.2	16.4	406.0
MBZ + CDF (150 + 45) g ha^{-1}	0.37	208.9	16.0	405.0
MBZ + PDN (150 + 40) g ha^{-1}	0.38	206.4	15.4	401.0
MBZ + FNP (150 + 100) g ha^{-1}	0.38	205.3	15.2	398.0
Weed free	0.40	201.1	14.5	394.0
Weedy check	0.35	212.9	16.8	408.0
SEm±	0.20	3.1	0.9	4.6
CD (5%)	NS	9.4	NS	NS

Residual nutrients in soil

Soil analysis data (Table 3) taken at harvest of crop revealed that no significant difference due to any of the varieties or weed management practices was observed on organic carbon (%), available P_2O_5 and K_2O during both the years, however, available N was significantly affected by the treatments. Maximum available nitrogen was found in plots where wheat variety WH 1124 (212.6 and 212.1 kg ha^{-1}) was grown being at par with DBW 17 and differed significantly from the plots of rest of wheat varieties during 2014-15 and 2015-16, respectively. Availability of soil nitrogen was significantly lower in weed. free plots as compared to plots with metribuzin application and weedy check plots during both the years. Weedy check plots recorded highest available nitrogen (212.5 and 211.9 kg ha^{-1}) during 2014-15 and 2015-16, respectively.

In conclusion, any of the herbicide treatment did not exhibit serious phytotoxicity to any of the wheat varieties (except minor effect on variety HD 2967 which recovered quickly and didn't affect the plant height and grain yield) in experiment however herbicidal sensitivity needs to be determined before using in the field conditions. There was no significant effect of weed management practices on residual organic carbon (%), available P_2O_5, and K_2O during both the years.

Acknowledgement

We are thankful to Dr. Jagdev Singh, Professor and Head, Department of Agronomy for providing necessary facilities and help rendered by staff during the research is gratefully acknowledged. The guidance and appraisal of Dr. Samunder Singh and the advisory committee members Dr. R.K. Nanwal, Dr. K.D. Sharma, Dr. P.S. Sangwan and Dr. R.S. Dhillon is thankfully acknowledged.

References

Anonymous, 2018. Statistical Abstract of Haryana 2016-17. *Department of Economic and Statistical Analysis, Haryana*.

Chhipa, K. G. and Nepalia, V. 2015. Effect of weed control and phosphorus sources on productivity of wheat (*Triticum aestivum*). *Indian J. Agric. Res.* 49 (2): 180-184.

Chhokar, R. S., Sharma, R. K., Sharma, I. 2012.Weed management strategies in wheat- A review. *J. Wheat Res* 4: 1-21.

Choudhary, D., Singh, P. K., Chopra, N. K. and Rana S. C. 2016. Effect of herbicides and herbicide mixtures on weeds in wheat. *Indian J. Agric. Res.* 50 (2): 107-112.

Hussain, M., Niaz, M., Iqbal, M., Iftikhar, T. and Ahmad., J. 2012. Emasculation techniques and detached tiller culture in wheat X maize crosses. *J. Agric. Res.*, 50 (1): 1-19.

Kler, D. S., Kaur, R. and Kaur, G. 2002. Planting techniques and plant density for weed control in wheat- A review. *Environment and Ecology* 20 (4): 930-941.

Kumar, S., Rana, S. S., Ramesh and Chander, N. 2013. Herbicide combinations for broad-spectrum weed control in wheat. *Indian J. Weed Sci.* 45 (1): 29–33.

Malik, R. K. and Singh, S. 1995. Littleseed canary grass (*Phalaris minor*) resisitance to isoproturon in India. *Weed Technol.* 9: 419-425.

Ramesh, K., Rao, A. N. and Chauhan, B. S. 2017. Role of crop competition in managing weeds in rice, wheat, and maize in India: A review. *Crop protection* 95: 14-21.

Runyan, T. J., McNeil, W. K. and Peeper, T. F. 1982. Differential tolerance of wheat (*Triticum aestivum*) cultivars to metribuzin. *Weed Science* 30: 94–97.

Sardana, V., Mahajan, G., Jabran, K. and Chauhan, B. S. 2017. Role of competition in managing weeds: An introduction to the special issue. *Crop Protection* 95: 1-7.

Sharma, R., Pahuja, S. S., Balyan, R. S., Malik, R. K. 2002. Effect of sulfonylurea herbicides applied alone and tank-mix with metribuzin on weeds and their residual effect on succeeding crop of sorghum. *Indian J. Weed Sci.* 34: 178-183.

Singh, S., Dhaka, A. K. and Hooda, V. S. 2015. Evaluation of Traxos 5% EC (Pinoxaden + Clodinofop propargyl) against *Phalaris minor* and other grassy weeds in Wheat. *Haryana J. Agron.* 31 (1&2): 1-8.

Singh, S., Singh, K., Punia, S. S., Yadav, A. and Dhawan, R. S. 2011. Effect of stage of *Phalaris minor* on the efficacy of accord plus (fenoxaprop + metsulfuron, ready-mix). *Indian J. Weed Sci.* 43: 23-31.

USDA (2017): World Agricultural Production, USDA, USA.

Yadav, A. and Malik, R. K. 2005. Herbicide-resistant *Phalaris minor* in wheat - A sustainability issue. *Resourse Book. Department of Agronomy and Directorate of Extension Education, CCSHAU, Hisar, India.* P. 152.

Yadav, A., Hooda, V. S., Bir, Dharam, Duhan, A., 2012. Screening the sensitivity of wheat varieties against fenoxaprop + metribuzin. *In: Proc. National Seminar on Sustainable Agriculture and Food Security: Challenges in Changing Climate March, 27-28 2012. Directorate of Research, CCS HAU, Hisar,* Pp. 255-256.

Yadav, A., Malik, R. K., Chauhan, B. S., Gill, G. 2002. Present status of herbicide resistance in Haryana. In: Malik, R.K., Balyan, R.S., Yadav, A., Pahwa, S.K. (Eds.), *Proc. Int. Workshop on Herbicide Resistance Management and Zero-tillage in Rice- Wheat Cropping System, March, 4-6, 2002. CCS HAU, Hisar, India, P*p. 15-22.

Yadav, D. B., Yadav, A., Punia, S. S. and Chauhan, B. S. 2016. Management of herbicide-resistant *Phalaris minor* in wheat by sequential or tank-mix applications of pre- and post-emergence herbicides in North-Western Indo-Gangetic Plains. *Crop Protection* 89: 239-247.

Yaduraju, N. T. and Mishra, J. S. 2002. Zero tillage in rice-wheat cropping system on vertisols in Madhya Pradesh - prospects and problems, Pp.117-119. In: *Proceedings of International Workshop on "Herbicide Resistance Management and Zero Tillage in Rice-Wheat Cropping System. CCS HAU, Hisar, India. March, 4-6, 2002.*

How to cite this article:

Sarita Rani, Suresh Kumar, V.S. Hooda, and Jagdish Parshad. 2018. Influence of Varieties and Herbicide Mixtures on Wheat Based Cropping System in Relation to Phytotoxicity and Residual Soil Nutrients. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 3573-3581.
doi: https://doi.org/10.20546/ijcmas.2018.706.420