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Effect of herbicides on weed-crop association in wheat

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ABSTRACT

Terai region has the characteristic of high rainfall and high humidity triggering aggressive growth of weeds, which in turn, become one of the major constraints in crop production during rabi season. The major weed flora observed in experiment were Polygonum orientale, P. pensylvanicum, P. persicaria, Stellaria media, S. aquatica, Oldenlandia diffusa, Hydrocotyl ranunculoides, Physalis minima, Eclipta alba, Cynodon dactylon, Setaria glauca and Digitaria sanguinalis. Three years study in wheat indicated that continuous application of 2,4-D, pendimethalin and metribuzin triggered shifting of weed flora. Continuous use of 2,4-D triggered emergence of Physalis minima in the place of several species of Polygonum, a common weed flora in wheat and that Physalis minima was not controlled even at higher dose of 2,4-D (0.8 kg ha^{-1}). Physalis minima was also not controlled with the use of metsulfuron methyl at its higher dose (16 g ha^{-1}). Similarly in sole pendimethalin treated plot, shifting was observed in favour of Hydrocotyl ranunculoides and Eclipta alba and that led to significant yield reduction in third year of experimentation. Application of metribuzin led to the emergence of Solanum nigrum which was completely absent in all other herbicide treated plots including weedy control treatment. Emergence of grasses was also observed in metribuzin treated plots of wheat. In integrated weed management practices, pendimethalin 0.5 kg ha^{-1} + hand hoeing at 35 days after sowing recorded higher weed control efficiency (81-86%) and yield (43.90q ha^{-1}) which was comparable to complete weed free situation (44.50 q ha^{-1}) and farmer's practices (44.31 q ha^{-1}) with highest net return (Rs. 38733/-) and benefit cost ratio (1.93).

Key words: Isoproturon**,** pendimethalin, metribuzin and metsulfuron.

Wheat is one of the most important *rabi* cereals contributing approximately 30-35% of total food grain production in our country. Heavy infestation of weeds alone causing 33% reductions in yield is a serious constraint in sustaining productivity of wheat. The extent of yield reduction largely depends on growth behavior of individual weed species in relation to agro-ecological condition (Singh *et al.,* 1997). In addition, high rainfall and multiple micro-nutrient deficiencies in *terai* region of West Bengal aggravate weed infestation during winter season. Among the herbicides, isoproturon and pendimethalin are being used for the last two decades in wheat for management of grassy weeds (Walia *et al.,* 1998 and Chopra *et al.,* 2001). For controlling broadleaved weeds along with grasses, application of isoproturon in combination of 2,4-D, sulfosulfuron and metsulfuron-methyl (MSM) are recommended (Pandey *et. al.*, 2006, Singh and Singh, 2002). In recent year, metribuzin has been found effective against associated weeds of wheat (Dixit and Bhan, 1997). Continuous use of isoproturon led to the development of evolutionary resistant biotype and shift in weed flora (Malik and Singh, 1995). A number of herbicides are, therefore, necessary to be evaluated for controlling weeds from the point of eco-safety under the present day of sustainable agriculture. Therefore, keeping all these views in mind, present study was conducted with the objective to workout integrated weed management practices for the management of weeds in wheat under *terai* agro-ecological region of West Bengal.

MATERIALS AND METHODS

The experiment was carried out during winter seasons of 2007-08 in the farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar ($26^0$19'86"N latitude and $89^0$23'53" E longitude). The soil was sandy loam in texture having a pH 5.34-5.8 and 0.75% organic carbon, low in available nitrogen (98.95 kg ha^{-1}), medium in available phosphorus (17.24 kg ha^{-1}), low in available potassium (79.24 kg ha^{-1}). The 12 treatments of the experiment were 2,4-D 0.5 kg/ha, 2,4-D 0.8 kg ha^{-1}, pendimethalin 0.5 kg ha^{-1}, pendimethalin 0.5 kg ha^{-1} + hoeing at 35 days after sowing, isoproturon 0.75 kg ha^{-1} + 2,4-D 0.5 kg ha^{-1}, metribuzine 0.2 kg ha^{-1} + hoeing at 35 days after sowing, metribuzine 0.3 kg ha^{-1}, isoproturon 0.75 kg ha^{-1} + metsulfuron methyl 8.0 g ha^{-1}, isoproturon 0.75 kg ha^{-1} + metsulfuron methyl 16.0 gha^{-1}, farmers practice (hoeing at 20 days after sowing + two hand weeding at 30 and 45 days after sowing), weedy control and complete weed free treatment. The treatments were laid out in randomized complete block design with three replications. Wheat variety "PBW-343" was sown at 22.5 cm apart on 20 November 2007 with the fertilizer dose of 120 kg N ha^{-1}, 60 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1}. Weed count and weed dry biomass were recorded at 40 and 60 days after sowing from the area enclosed by a quadrate of 0.25 m^2 randomly selected at two places in each plot. Weed data were subjected to square root transformation ($\sqrt{}$ X +0.5) before statistical analysis. The herbicides 2,4-D and metsulfuron methyl (MSM) were applied as post-emergence at 30 days after sowing, whereas pendimethalin, isoproturon and metribuzin were applied as pre-emergence with knapsack sprayer fitted with flood jet nozzle using spray volume of 550 lit./ha of water

RESULTS AND DISCUSSION

Effect on weed

The major weed flora observed in the weedy control plots were *Polygonum orientale*, *P. pensylvanicum, P. persicaria, Stellaria media, S. aquatica, Oldenlandia diffusa, Hydrocotyl ranunculoides, Physalis minima, Eclipta alba*, *Cynodon dactylon*, *Setaria glauca* and *Digitaria sanguinalis*. The dominant weed flora in these areas are several species of *Polygonum* and *Stellaria* having higher competitive ability and damaging potential than other broadleaved weeds. Population and dry matter accumulation of weeds

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were lower in all the weed management treatments under study in comparison to weedy control treatment (Table-1 and 2). This was third year experimentation in which treatments were modified based on shifting of weed flora. During 2005-06, sole application of 2,4-D 0.5 kg ha^{-1} caused weed control efficiency of 71% at 60 DAS. However, in second year and third year, weed control efficiency was reduced to 24 and 21%, respectively as a result of emergence of relatively tolerant weed species *Physalis minima* and re-growth of *Stellaria media*. Even higher dose of 2,4-D at 0.8 kg ha^{-1} also recorded poor weed control efficiency (26%). The weed *Physalis minima* was relatively tolerant to 2,4-D as well as metsulfuron methyl (MSM). The result showed that the treatments isoproturon 0.70 kg ha^{-1} followed by 2, 4-D 0.5 kg ha^{-1} or metsulfuron methyl 8 g ha^{-1} or metsulfuron methyl 16 g ha^{-1} recorded weed control efficiency of 37-38% or 31-33% or 35-36% in third year, respectively (Table 2). Similarly application of pendimethalin controlled more than 80% of the weeds in first year however, its continuous application in succeeding year reduced weed control efficiency due to emergence of *Hydrocotyl ranunculoide* and *Eclipta alba.* Aggressive growth of these weeds caused significant yield reduction of wheat in third year of sole pendimethalin treated plots. Among the treatments of integrated weed management practices, pendimethalin 0.5 kg ha^{-1} + hand hoeing recorded lowest weed dry matter accumulation (12.35 and 25.29 g m^{-2} at 40 DAS and 60 DAS, respectively) with highest weed control efficiency (81-86%).

Yield and economics

Among the treatments, highest grain yield was recorded in complete weed free situation (44.5 q ha^{-1}) which was at par with farmers' practices (44.3 q ha^{-1}) as well as pendimethalin 0.5 kg ha^{-1} + hand hoeing (43.9 q ha^{-1}). Pendimethalin 0.5 kg ha^{-1} + hand hoeing was effective in controlling *Hydrocotyl ranunculoides* and *Eclipta alba* and was significantly superior than sole application of pendimethalin 0.5 kg ha^{-1}. Whereas, among the herbicidal treatments, the lowest yield (19.9 q ha^{-1}) was recorded in 2,4-D 0.5 kg ha^{-1} and 2,4-D 0.8 kg ha^{-1} (21.4q ha^{-1}) as a result of poor weed control efficiency due to shifting of broadleaved weeds *Physalis minima* and emergence of *Stellaria media* and *Stellaria aquatica*. High value of weed control efficiency with high weed index indicates phytotoxic effect of metribuzin on wheat at the dose of 0.3 kg ha^{-1} resulting in lower grain yield. However, metribuzin 0.2 kg ha^{-1} + hand hoeing provided good control over problematic broadleaved weeds and recorded the yield comparable with sole application of pendimethalin 0.5 kg ha^{-1}. Combination of isoproturon 0.75 kg ha^{-1} and 2,4-D 0.5 kg ha^{-1} or metsulfuron methyl at the dose of 8 to 16 g ha^{-1} could not control the broadleaved weeds like *Polygonum* sp., *Stellaria* sp. and *Physalis minima* effectively and that in turn resulted in lower grain yield.

The treatment pendimethalin 0.5 kg ha^{-1} + hand hoeing recorded the highest net return (Rs.38,733 ha^{-1}) with the higher benefit cost ratio (1.93), as compared to farmers practice (Net return of Rs. 31,443 ha^{-1} and benefit cost ratio of 1.13). The treatment pendimethalin 0.5 kg ha^{-1} + hand hoeing was closely followed by the treatments of sole pendimethalin application at the dose of 0.5 kg ha^{-1} (Net return of Rs. 37008 ha^{-1} and benefit cost ratio of 1.91) and metribuzin 0.2 kg ha^{-1} + hand hoeing (Net return of Rs. 36,212 ha^{-1} and benefit cost ratio of 1.84) (Table 2).

It has been concluded from the above findings that integrated weed management practices comprising pendimethalin 0.5 kg ha^{-1} as pre-emergence + hand hoeing at 35 days after sowing or metribuzin 0.2 kg ha^{-1} as pre-emergence + hand hoeing at 35 days after sowing could become effective in minimizing weed pressure of broadleaved weeds like *Polygonum* sp., *Stellaria* sp. and *Physalis minima* as well as reducing chances of shifting of weed flora in wheat resulting in higher grain yield and maximization of profit in wheat cultivation.

REFERENCES

Chopra N., Singh H., Tripathi, H.P., Chopra, N.K., Chopra, N. and Singh, H. 2001. Performance of metsulfuron methyl and pendimethalin alone and their mixtures with isoproturon on weed control in wheat (*Triticum aestivum*) seed crop. *Indian J. Agron.* **46**: 239-45

Dixit, A. and Bhan, V.M. 1997. Efficiency of metribuzin for controlling weeds in wheat. *Ann. Rep. NRC Weed Sci.* pp. 23.

Pandey, I.B., Dwivedi, D. K. and Prakash, S.C. 2006. Impact of method and levels of fertilizer application and weed management on nutrient economy and yield of wheat (*Tritium aestivum*). *Indian J. Agron..* **53**: 193-98

Singh G. and Singh M. 2002. Bio-efficacy of metsulfuron methyl in combination with isoproturon for control of grassy and non grassy weeds in wheat. *Indian J. Weed Sc*. **34**: 9-12.

Singh, R. K., Singh, D. K. and Singh, R.P. 1997. Weed crop completion in wheat as affected by different weed species. *Indian J. Weed Sci.* **29**: 109.

Walia, U.S., Brar, L.S. and Dhaliwal, B.K. 1998. Performance of clodinafop and fenoxaprop –p-ethyl for the control of *Phalaris minor* in wheat. *Indian J. Weed Sci.*.**30** : 48-50.

Malik, R.K. and Singh, S. 1995. Little seed canary grass (*Phalaris minor* Retz.) resistant to isoproturon in India. *Weed Tech.* **9**: 419-425.

Table 1: Effect of different on density of weed flora in wheat (no. / m^2)

Treatment	40 DAS						60 DAS					
	Broadleaved weeds					Grassy weeds	Broadleaved weeds					Grassy weeds
	***Polygonum* spp**	***Stellaria media***	***Physalis minima***	***Hydrocotyl ranunculoids***	**Others**		***Polygonum* spp**	***Stellaria media***	***Physalis minima***	***Hydrocotyl ranunculoids***	**Others**	
2,4-D- 0.5 kg ha^{-1}	6.16 (38)	15.00 (225)	5.59 (31)	1.19 (4)	2.31 (5)	3.49 (13)	6.44 (42)	15.20 (231)	6.66 (44)	2.16 (5)	2.70 (7)	4.31 (19)
2,4-D- 0.8 kg ha^{-1}	5.71 (33)	14.25 (203)	5.06 (26)	1.52 (2)	1.99 (4)	3.33 (12)	6.10 (37)	14.43 (208)	5.71 (33)	1.71 (3)	2.36 (6)	4.27 (18)
Pendimethalin 0.5 kg ha^{-1}	2.83 (8)	2.95 (9)	1.13 (1)	12.67 (161)	8.10 (66)	5.23 (27)	3.10 (10)	3.10 (11)	1.27 (2)	14.92 (223)	8.43 (71)	5.82 (34)
Pendimethalin 0.5 kg ha^{-1} + hand hoeing	1.27 (2)	1.71 (3)	1.00 (1)	7.19 (52)	4.11 (17)	3.96 (16)	1.68 (3)	2.20 (5)	1.38 (1)	13.99 (196)	4.32 (19)	4.32 (19)
Isoproturon 0.75 kg ha^{-1} + 2,4-D 0.5 kg ha^{-1}	7.14 (51)	9.20 (85)	5.00 (25)	1.51 (2)	2.16 (5)	3.19 (11)	7.48 (56)	9.60 (92)	5.69 (32)	1.69 (3)	2.35 (6)	3.49 (12)
Metribuzine 0.2 kg ha^{-1} + hand hoeing	2.30 (5)	3.30 (11)	1.13 (1)	1.27 (2)	5.47 (30)	4.75 (23)	2.56 (7)	3.51 (13)	1.27 (2)	1.39 (3)	6.13 (37)	5.13 (26)
Metribuzine 0.3 kg ha^{-1}	1.99 (4)	2.50 (6)	1.13 (1)	1.27 (2)	6.07 (37)	5.62 (32)	2.16 (5)	2.81 (8)	1.27 (2)	1.13 (2)	6.64 (42)	6.73 (45)
Isoproturon 0.75 kg ha^{-1} + Metsulfuron methyl 8.0g ha^{-1}	5.97 (36)	8.79 (77)	4.83 (23)	1.38 (1)	2.36 (6)	3.14 (11)	6.08 (37)	8.97 (81)	5.63 (32)	1.0 (1)	2.63 (7)	3.89 (15)
Isoproturon 0.75 kg ha^{-1} + Metsulfuron methyl 16.0 g ha^{-1}	5.57 (31)	8.51 (72)	4.51 (20)	1.13 (1)	2.16 (5)	2.88 (9)	5.74 (33)	8.82 (78)	5.26 (27)	1.0 (1)	2.57 (7)	3.62 (14)
Farmers practice	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)
Weedy control	7.85 (61)	15.26 (223)	1.71 (3)	1.79 (4)	5.09 (26)	5.80 (34)	8.14 (66)	15.42 (238)	2.48 (6)	2.54 (7)	6.19 (38)	7.11 (51)
Complete weed free	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)	0.70 (0)
SEm (±)	**0.16**	**0.28**	**0.16**	**0.18**	**0.19**	**0.50**	**0.23**	**0.36**	**0.19**	**0.31**	**0.31**	**0.32**
LSD (0.05)	**0.33**	**0.59**	**0.33**	**0.39**	**0.40**	**1.04**	**0.48**	**0.75**	**0.39**	**0.65**	**0.64**	**0.67**

DAS- Days after sowing, Data transformed to $\sqrt{X + 0.5}$, figures in parentheses indicate original values.

Table 2: Effect of different treatments on weed dry weight (g. m^{-2}), weed control efficiency (%), yield and yield attributing characters of wheat

Treatment	Weed dry weight (g m^{-2})		Weed control efficiency (%)		Plant height (cm)	No of ear head (m^2)	No of filled grains $earhead^{-1}$	Test weight (g)	Yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Weed index (%)	Net income, Rs ha^{-1}	Benefit : cost ratio
	40DAS	60DAS	40DAS	60DAS										
2,4-D- 0.5 kg ha^{-1}	8.4 (71.3)	10.5 (110.9)	24.8	20.8	86.6	240.0	37.5	37.5	19.9	34.0	36.9	55.3	9675	0.51
2,4-D- 0.8 kg ha^{-1}	8.4 (69.7)	10.4 (108.2)	26.0	22.7	86.9	249.0	37.9	37.9	21.4	36.3	37.0	52.0	11510	0.61
Pendimethalin 0.5 kg ha^{-1}	4.6 (21.2)	5.9 (35.3)	77.5	74.8	90.2	356.7	48.6	41.4	41.9	58.2	41.8	5.9	37008	1.91
Pendimethalin 0.5 kg ha^{-1} + hand hoeing	3.5 (12.4)	4.9 (25.3)	86.8	81.8	90.2	375.0	49.6	42.1	43.9	59.6	42.4	1.4	38733	1.93
Isoproturon 0.75 kg ha^{-1} + 2,4-D 0.5 kg ha^{-1}	7.6 (59.1)	9.3 (86.1)	37.2	38.5	87.5	274.3	38.8	38.2	26.0	42.4	38.0	41.5	16946	0.86
Metribuzine 0.2 kg ha^{-1} + hand hoeing	5.2 (26.7)	6.1 (36.78)	71.7	73.7	90.2	354.3	48.6	41.4	41.4	57.8	41.7	6.9	36212	1.84
Metribuzine 0.3 kg ha^{-1}	4.2 (17.5)	5.9 (34.8)	81.4	75.1	89.4	353.7	48.3	41.1	38.7	54.7	41.4	13.1	33228	1.74
Isoproturon 0.75 kg ha^{-1} + Metsulfuron methyl 8.0g ha^{-1}	7.9 (62.8)	9.8 (96.7)	33.3	30.9	87.2	267.7	38.7	38.1	24.5	41.5	37.1	45.0	14831	0.74
Isoproturon 0.75 kg ha^{-1} + Metsulfuron methyl 16.0 g ha^{-1}	7.8 (60.6)	9.5 (91.1)	35.6	34.9	87.3	272.3	38.7	38.2	25.5	41.7	37.9	42.8	15214	0.73
Farmers practice	0.7 (0)	0.7 (0)	100	100	90.3	374.3	49.9	42.2	44.3	59.7	42.6	0.4	31443	1.13
Weedy control	9.7 (94.2)	11.8 (140.1)	-	-	85.2	226.3	33.2	36.1	16.1	29.5	29.6	63.8	5673	0.31
Complete weed free	0.70 (0)	0.70 (0)	100	100	90.3	384.7	49.9	42.2	44.5	59.9	35.3	-	29683	0.99
SEm (±)	**0.30**	**0.24**	**-**	**-**	**0.24**	**5.32**	**0.67**	**0.22**	**0.30**	**0.32**	**42.6**	**-**	**-**	**-**
LSD (0.05)	**0.62**	**0.49**	**-**	**-**	**0.49**	**11.04**	**1.39**	**0.46**	**0.61**	**0.67**	**-**	**-**	**-**	**-**

DAS- Days after sowing, Data transformed to √ X + 0.5, figures in parentheses indicate original values.