



# BIO-EFFICACY AND PHYTOTOXICITY OF METSULFURON-METHYL 20% (WG) AGAINST BROAD LEAF WEEDS IN WHEAT CROP

AN Singh Ninama, Nidhi Verma\*, Deepak Khende and R. S. Kushwah

Zonal Agriculture Research Station, Powarkheda (Hoshangabad), Madhya Pradesh, India.

## Abstract

A field experiment was conducted during *Rabi* season of 2006-07 at Research Farm of the Department of Agronomy, Collage of Agriculture, Gwalior (M.P.), India to evaluate the Bio-Efficacy and Phytotoxicity of Metsulfuron-Methyl 20% (WG) against broad leaf weeds in Wheat (*Triticum aestivum*). Major dominant weeds infesting the wheat crop were *Chenopodium album*, *Anagallis arvensis*, *Phalaris minor* and *Melilotus alba*. Application of metsulfuron methyl at the rate of 8g + 0.2% surfactant/ha was found most effective to control the weeds and for reducing their dry weight and also higher grain yield, which was closely followed by the application of metsulfuron-methyl 4g + 25g Sulfosulfuron/ha. Both the treatments also recorded higher and almost identical net income per rupee investment (Rs. 3.32 and 3.25).

**Key words :** Wheat, *Phalaris minor*, metsulfuron-methyl, yield.

## Introduction

Wheat is one of the most important cereal crops of the world. In India, it is second important staple food crop, rice being the first. The irrigated wheat is infested with several broad leaf weeds, which create competitive stress resulting in yield losses varying from 7 to 50% depending upon their density (Jat *et al.*, 2005). At present, 2, 4-D as post emergence is an effective herbicide to control the broad leaf weeds in wheat, but has sown little control of several non grassy weeds. Therefore, there is urgent need to have alternative herbicides, which may provide wide range of weed control. In this direction, some new sulfonyl urea herbicides were tested alone and in and in combination to find out their efficacy.

## Materials and Methods

The present experiment was conducted during *Rabi* season of 2006-07 at Research Farm of the Department of Agronomy, Collage of Agriculture, Gwalior (M.P.), India. The soils of the experimental field was neutral in reaction (7.7 pH) with low in OC content (0.41g/kg), medium in available N (180 Kg/ha) and available K (238.6 Kg/ha) but low in available P (28.6 Kg/ha). Post-emergence application of Metsulfuron-methyl 3g + 0.2% surfactant/ha POE, Metsulfuron-methyl 4g + 0.2% surfactant/ha POE, Metsulfuron-methyl 5g + 0.2%

surfactant/ha POE, Metsulfuron-methyl 8g + 0.2% surfactant/ha POE, Metsulfuron-methyl 4g/ha POE, 2, 4-D Sodium Salt 500g/ha POE, Metsulfuron-methyl 4g + 0.2% urea/ha POE, Metsulfuron-methyl 4g + 25g sulfosulfuron/ha POE, Hand weeding-weed free check (25 and 50 DAS) and Untreated control were laid out in randomized block design with three replication. Wheat variety MP-4010 was sown on November 14, 2006 at 22.5 cm row to row spacing and using 100 kg seed per hectare. The quantity of herbicides as per treatment was sprayed by hand sprayer in respective plots with flat-fan nozzle. The water was used @ 600 litre per hectare. The crop was raised under irrigated condition with recommended package and practices. The density (no./m<sup>2</sup>) and dry weight of weeds (g/m<sup>2</sup>) were recorded at 30, 45 days and at harvest after treatment by placing a quadrate of 0.50 m × 0.50 m (0.25 m<sup>2</sup>) size randomly at four places in a plot. The data on number and dry weight of weeds were subjected to square root transformation ( $\sqrt{x + 0.5}$ ) before statistical analysis.

## Results and Discussion

### Effect on weeds

The major weed flora in the experimental field were *Phalaris minor*, *Chnopodium album*, *Anagallis arvensis*, *Cyprus rotundus*, *Convolvulus arvensis*, *Fumaria parviflora*, *Amaranthus virids*, *Meliotus alba*,

\*Author for correspondence: E-mail : nitu.verma02@gmail.com

**Table 1:** Effect of weed control treatments on Growth and yield attributing characters at harvest in wheat

S. no.	Treatment	Plant population/m row length	Plant height (cm)	No of tillers/m length	Length of earhead (cm)	No of grains/earhead	Test weight
1.	Metsulfuron-methyl 3g + 0.2% surfactant/ha POE	63.33	70.26	190.0	8.03	39.13	32.09
2.	Metsulfuron-methyl 4g + 0.2% surfactant/ha POE	65.33	71.66	189.0	8.13	41.67	34.97
3.	Metsulfuron-methyl 5g + 0.2% surfactant/ha POE	63.00	74.06	256.0	8.26	42.73	35.06
4.	Metsulfuron-methyl 8g + 0.2% surfactant/ha POE	65.00	75.06	256.0	8.26	43.60	37.49
5.	Metsulfuron-methyl 4g/ha POE	66.00	70.23	183.0	7.93	38.06	32.93
6.	2, 4-D Sodium Salt 500g/ha POE	63.33	70.20	184.0	8.06	39.06	31.56
7.	Metsulfuron-methyl 4g + 0.2% urea/ha POE	63.00	70.13	185.0	8.20	40.13	32.73
8.	Metsulfuron-methyl 4g + 25g sulfosulfuron/ha POE	63.33	70.16	245.3	8.12	41.46	38.63
9.	Hand weeding – weed free check (25 and 50 DAS)	66.00	76.00	267.0	8.46	43.46	40.90
10.	Untreated control	60.66	69.00	176.0	7.86	38.06	30.40
	<b>SEm±</b>	<b>2.19</b>	<b>0.32</b>	<b>7.34</b>	<b>0.19</b>	<b>1.49</b>	<b>0.25</b>
	<b>CD (P=0.05)</b>	<b>NS</b>	<b>0.96</b>	<b>22.02</b>	<b>0.57</b>	<b>4.47</b>	<b>0.75</b>

*Cynodon dactylon*, *Spergula arvensis* and *Parthenium hysterophorus*.

Among these different weed flora maximum population was observed by *Chenopodium album* while the minimum population was recorded by *Cynodon dactylon*. Maximum weed population was observed in untreated control treatment at harvest stage in *Chenopodium album* (233.33), while *Convolvulus arvensis* and *Cyperus rotundus* had minimum (4.66) weed population. All the herbicides reduced the population of weeds with each spray after 30, 45 and at harvest of sowing. Hand weeding- weed free check (25 and 50 DAS) gave nearly complete control of weeds at all stage of observations. The next herbicide treatment in respect of reducing the weed population was metsulfuron-methyl 8g+0.2% surfactant followed by metsulfuron-methyl 5g+0.2 % surfactant except *Chenopodium album* 30 and 45 *Fumaria parviflora*, *Amaranthus viridis*, *Spergula arvensis*, *Parthenium hysterophorus* and *Phalaris minor* were totally reduced by all the herbicides at harvest stage except untreated control treatment. Similar results were obtained by Kurchania *et al.* (2000) and Jat *et al.* (2005).

Among different weed control treatments hand weeding- weed free check (25 & 50 DAS) recorded lowest dry weight of weeds at both stage of observations, followed by metsulfuron-methyl at the rate of 8g + 0.2% surfactant/ha among herbicidal treatments. Similarly maximum weed control efficiency (89.215) was exhibited

by weed free treatment, followed by metsulfuron-methyl at 8g (87.36%) and 4g (83.02%) with 0.2% surfactant/ha. Similar results were reported by Singh and Singh (2005) and in the Annual report (2006).

#### Effect of crop

Plant population, plant height, test weight were not affected significantly due to herbicide. Yield attributing character, viz. number of tillers /m row length, number of grains/ear head and weight of grains (g), grain yield (qha<sup>-1</sup>) were significantly influenced due to application of metsulfuron-methyl. Growth parameters [plant height, number of tillers (m<sup>-2</sup>) and leaf area index] and yield attributes (effective tillers m<sup>-2</sup>, ear length, grains/ear, weight of grains/ear and 1000-grains weight) as well as grain yield were superior under application of weed free check compared to metsulfuron-methyl 8g+0.2% surfactant/ha. The results are in accordance with the finding of Jat *et al.* (2003). However, maximum grain yield of wheat (49.44q ha<sup>-1</sup>) was recorded from hand-weeding –weed free check at 25 and 50 days after sowing. The lowest grain yield (33.58qha<sup>-1</sup>) was obtained from untreated control. The weed index value was minimum under Metsulfuron-methyl 8g + 0.2% surfactant/ha POE (015%) treatment, which gave an indicative that yield losses due to weed competition was minimum and effective control of weeds compared to rest of treatments.

#### Economics

Application of metsulfuron methyl 8g+0.2%

**Table 2:** Influence of weed control treatments on weed density, 30, 45 and at harvest DAT in wheat

T. No.	Treatments	<i>Chnopodium album</i>			<i>Anagallis arvensis</i>			<i>Fumaria parviflora</i>			<i>Melilotus alba</i>			<i>Amaranthus viridis</i>		
		30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest
1.	Metsulfuron-methyl 3g + 0.2% surfactant/ha POE	16 (2.77)	12.67 (2.54)	4.00 (1.57)	3.33 (1.79)	2.66 (1.77)	1.33 (1.26)	1.33 (1.17)	0.66 (0.99)	0.33 (0.87)	4.00 (1.91)	3.00 (1.28)	1.33 (1.28)	1.33 (1.17)	1.66 (1.25)	0.00 (0.07)
2.	Metsulfuron-methyl 4g + 0.2% surfactant/ha POE	3.66 (1.53)	2.66 (1.26)	2.00 (1.09)	3.33 (1.95)	1.66 (1.46)	0.66 (1.05)	1.66 (1.25)	0.66 (0.99)	0.33 (0.87)	2.66 (1.64)	1.33 (1.72)	0.66 (1.05)	0.00 (0.07)	0.00 (0.07)	0.00 (0.07)
3.	Metsulfuron-methyl 5g + 0.2% surfactant/ha POE	4.33 (1.67)	5.00 (1.73)	0.66 (0.46)	2.33 (1.56)	1.66 (1.38)	1.00 (1.17)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.07)	0.00 (0.07)	0.00 (0.07)
4.	Metsulfuron-methyl 8g + 0.2% surfactant/ha POE	2.66 (1.19)	2.00 (1.05)	0.33 (0.23)	0.33 (0.87)	0.66 (0.99)	0.66 (0.99)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.07)	0.00 (0.07)	0.00 (0.07)
5.	Metsulfuron-methyl 4g/ha POE	4.33 (1.67)	5.00 (1.62)	2.00 (1.09)	3.00 (1.72)	2.00 (1.42)	0.66 (0.99)	0.66 (0.99)	0.33 (0.87)	0.00 (0.70)	1.33 (0.70)	0.33 (0.87)	1.00 (0.99)	0.00 (0.07)	0.00 (0.07)	0.00 (0.07)
6.	2, 4-D Sodium Salt 500g/ha POE	11 (2.39)	11.34 (2.35)	3.33 (1.43)	1.33 (1.17)	1.66 (1.79)	0.33 (0.87)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	4.66 (2.26)	2.66 (1.77)	0.00 (0.70)	1.00 (1.09)	0.00 (0.07)	0.00 (0.07)
7.	Metsulfuron-methyl 4g + 0.2% urea/ha POE	13.66 (2.68)	9.67 (2.36)	3.00 (1.38)	3.33 (1.79)	2.33 (1.67)	1.00 (1.17)	2.66 (1.64)	1.33 (1.28)	0.33 (0.87)	2.66 (1.64)	1.33 (1.26)	1.00 (1.17)	0.00 (0.07)	1.00 (1.09)	0.00 (0.07)
8.	Metsulfuron-methyl 4g + 2.5g sulfo sulfuron/ha POE	30.66 (3.41)	13.33 (2.61)	2.66 (1.19)	2.33 (1.54)	2.00 (1.46)	1.33 (1.28)	3.66 (2.01)	1.66 (1.46)	0.33 (0.87)	1.33 (1.17)	0.66 (0.87)	0.00 (0.70)	0.00 (0.07)	0.00 (0.07)	0.00 (0.07)
9.	Hand weeding – weed free check(25 and 50 DAS)	0.00 (0.00)	3.66 (1.53)	0.00 (2.54)	0.00 (0.70)	1.33 (1.17)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.07)	0.00 (0.07)	0.00 (0.07)
10.	Untreated control	275 (5.61)	161.67 (5.57)	233.33 (5.45)	16.00 (4.05)	14.33 (3.84)	16.00 (4.05)	8.66 (3.00)	7.33 (2.75)	8.00 (2.90)	12.66 (3.58)	10 (3.19)	8.33 (2.93)	6.00 (2.52)	4.66 (2.27)	4.66 (2.46)
	<b>SE<sub>me</sub></b>	<b>0.18</b>	<b>0.21</b>	<b>0.28</b>	<b>0.41</b>	<b>0.30</b>	<b>0.24</b>	<b>0.31</b>	<b>0.20</b>	<b>0.13</b>	<b>0.37</b>	<b>0.26</b>	<b>0.20</b>	<b>0.07</b>	<b>0.25</b>	<b>0.07</b>
	<b>CD (P=0.05)</b>	<b>0.54</b>	<b>0.64</b>	<b>0.83</b>	<b>1.23</b>	<b>0.92</b>	<b>0.73</b>	<b>0.93</b>	<b>0.60</b>	<b>0.39</b>	<b>1.10</b>	<b>0.78</b>	<b>0.60</b>	<b>0.22</b>	<b>0.74</b>	<b>0.22</b>

\*Data subjected to square root transformation and figures in parentheses are original values.  
 DAT- Days after treatment.

**Table 3 :** Influence of weed control treatments on weed density, 30, 45 and at harvest DAT in wheat.

T. No.	Treatments	<i>Chnopodium album</i>			<i>Parthenium hysterophorus</i>			<i>Cyndon dactilon</i>			<i>Cyprus rotundus</i>			<i>Phalaris minor</i>		
		30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest	30 DAS	45 DAT	At harvest
1.	Metsulfuron-methyl 3g + 0.2% surfactant/ha POE	0.66 (2.46)	1.66 (1.38)	0.66 (1.05)	1.66 (1.25)	1.00 (1.09)	0.00 (0.70)	2.00 (1.48)	1.33 (1.17)	1.33 (1.28)	4.00 (1.39)	2.66 (1.64)	0.66 (0.99)	2.33 (1.56)	1.33 (1.26)	0.66 (1.05)
2.	Metsulfuron-methyl 4g + 0.2% surfactant/ha POE	1.00 (1.17)	1.00 (1.17)	0.33 (0.87)	0.66 (0.99)	0.33 (0.87)	0.00 (0.70)	1.33 (1.34)	0.00 (0.70)	0.66 (1.05)	5.66 (2.41)	6.66 (2.67)	0.66 (0.99)	2.66 (1.71)	0.33 (0.07)	0.33 (0.87)
3	Metsulfuron-methyl 5g + 0.2% surfactant/ha POE	0.66 (2.46)	0.66 (0.99)	0.33 (0.87)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	1.33 (1.34)	0.00 (0.70)	0.00 (0.70)	5.33 (2.33)	4.33 (2.18)	0.33 (0.87)	1.66 (1.35)	1.00 (1.17)	0.00 (0.70)
4	Metsulfuron-methyl 8g + 0.2% surfactant/ha POE	0.00 (0.07)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	1.33 (1.34)	0.00 (0.70)	0.00 (0.70)	3.33 (1.39)	0.00 (0.70)	0.00 (0.70)	0.66 (0.99)	0.00 (0.07)	0.00 (0.70)
5	Metsulfuron-methyl 4g/ha POE	2.66 (1.76)	1.33 (1.34)	0.33 (0.87)	1.33 (1.17)	0.00 (0.70)	0.00 (0.70)	2.66 (1.77)	3.00 (0.70)	1.66 (1.46)	6.00 (2.52)	1.30 (1.28)	0.33 (0.87)	2.33 (1.49)	1.33 (1.34)	0.00 (0.70)
6	2, 4-D Sodium Salt 500g/ha POE	0.66 (1.17)	1.34 (1.17)	0.66 (0.99)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	1.66 (1.46)	0.66 (0.99)	1.66 (1.46)	7.00 (2.72)	7.00 (2.72)	0.66 (0.99)	2.33 (1.49)	1.33 (1.28)	0.00 (0.70)
7	Metsulfuron-methyl 4g + 0.2% urea/ha POE	2.34 (1.54)	2.00 (1.42)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	3.00 (1.83)	3.33 (1.79)	1.33 (1.28)	5.00 (2.28)	5.00 (2.28)	0.66 (0.99)	2.66 (1.64)	0.66 (0.99)	0.00 (0.70)
8	Metsulfuron-methyl 4g + 25g sulfosulfuron/ha POE	2.00 (1.46)	1.66 (1.38)	0.66 (0.99)	0.00 (0.70)	0.00 (0.70)	0.00 (0.70)	1.66 (1.34)	1.33 (1.17)	1.33 (1.17)	2.66 (1.44)	4.66 (2.30)	0.66 (0.99)	1.66 (1.34)	1.33 (1.28)	0.00 (0.70)
9	Hand weeding – weed free check (25 and 50 DAS)	0.00 (0.07)	2.00 (1.58)	0.00 (0.70)	0.00 (0.70)	0.66 (0.99)	0.00 (0.70)	0.00 (0.70)	2.00 (1.32)	2.00 (1.32)	1.66 (1.25)	1.00 (1.09)	2.00 (1.55)	0.66 (0.99)	0.00 (0.70)	0.00 (0.70)
10	Untreated control	8.66 (3.02)	8.34 (2.96)	4.66 (2.26)	14.0 (3.80)	12.0 (3.53)	14.0 (3.80)	6.66 (2.67)	7.33 (2.78)	7.33 (2.79)	18.33 (3.92)	11.33 (3.43)	4.66 (2.55)	7.00 (2.97)	5.33 (2.41)	5.33 (2.40)
	<b>CD (P=0.05)</b>	<b>0.29</b> <b>0.87</b>	<b>0.30</b> <b>0.91</b>	<b>0.17</b> <b>0.51</b>	<b>0.25</b> <b>0.75</b>	<b>0.16</b> <b>0.48</b>	<b>0.04</b> <b>0.12</b>	<b>0.17</b> <b>0.52</b>	<b>0.34</b> <b>1.02</b>	<b>0.16</b> <b>0.49</b>	<b>0.43</b> <b>1.27</b>	<b>0.26</b> <b>0.78</b>	<b>0.23</b> <b>0.69</b>	<b>0.30</b> <b>0.89</b>	<b>0.23</b> <b>0.68</b>	<b>0.11</b> <b>0.34</b>

\*Data subjected to square root transformation and figures in parentheses are original values.  
DAT- Days after treatment.

**Table 4 :** Weed dry weight, WCE, grain yield and economics of wheat as affected by herbicide treatments.

S. no.	Treatment	Weed dry weight (g/m <sup>2</sup> )		WCE (%)	Grain yield (kg/ha)	Cost of cultivation Rs <sup>-1</sup> ha <sup>-1</sup> year	Gross return Rs <sup>-1</sup> ha <sup>-1</sup> year	Net return Rs <sup>-1</sup> ha <sup>-1</sup> year	B:C ratio
		30 days after sowing	At harvest						
1.	Metsulfuron-methyl 3g + 0.2% surfactant/ha POE	3.61	1.53	79.86	3370	1465.12	35722	21057	2.43
2.	Metsulfuron-methyl 4g + 0.2% surfactant/ha POE	3.40	1.29	83.02	3827	14682.50	40564	25882	2.76
3.	Metsulfuron-methyl 5g + 0.2% surfactant/ha POE	3.25	1.59	79.07	4434	14697.87	47001	32303	3.19
4.	Metsulfuron-methyl 8g + 0.2% surfactant/ha POE	3.03	0.96	87.36	4620	14747.00	48973	34226	3.32
5.	Metsulfuron-methyl 4g/ha POE	3.37	1.69	77.76	3709	14681.50	39315	24633	2.67
6.	2, 4-D Sodium Salt 500g/ha POE	3.61	1.70	77.63	4043	14816.00	42854	28038	2.89
7.	Metsulfuron-methyl 4g + 0.2% urea/ha POE	3.46	1.64	78.42	3771	14683.67	39969	25285	2.72
8.	Metsulfuron-methyl 4g + 25g sulfosulfuron/ha POE	3.63	1.75	76.97	4518	14698.25	47887	33179	3.25
9.	Hand weeding – weed free check (25 and 50 DAS)	1.24	0.82	89.21	4628	17150.00	49055	31905	2.86
10.	Untreated control	3.71	7.60	-	1234	13430	35538	22108	2.64
<b>C.D. at (5%)</b>		<b>0.72</b>	<b>0.54</b>	-					

surfactant/ha fetched the highest net income of Rs. 34226 ha<sup>-1</sup>, which was closely followed by the application of metsulfuron-methyl 4g + 25g sulfosulfuron (Rs. 33189 ha<sup>-1</sup>). Both the treatments also recorded higher and almost identical net income per rupee investment (Rs. 3.32 and Rs. 3.25).

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