Indian J. Weed Sci. **40** (3 & 4) : 201-204 (2008) *Short Communication*

Evaluation of AE F130060 and MKH 6561 for Weed Control in Wheat

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Phalaris minor became the most dominating grass weed of wheat with the adoption of high yielding dwarf wheat varieties which were more responsive to fertilizers and moisture (Singh *et al.,* 1995). These conditions also favoured *P. minor* resulting in severe crop-weed competition and significant reduction in wheat yield. As *P. minor* emerges in several flushes during the growth period of wheat, mechanical weeding is less effective and cumbersome. PS II inhibitor herbicides were adopted on large scale for effective control of *P. minor* and other weeds during the eighties (Singh *et al*., 1999), but continuous use of isoproturon resulted in the evolution of resistance in *P. minor* biotypes in the rice-wheat rotation areas in north-west India (Malik and Singh, 1995; Singh *et al*., 1997). New herbicides were recommended for the control of isoproturon resistant biotypes in 1998 (Malik and Yadav, 1997; Chhokar and Malik, 2002) and the efficacy of some of them is questionable under farmers' fields (Chhokar and Sharma, 2008; Walia, 2008; Singh *et al*., 2009). *P. minor* biotypes have shown resistance to herbicides of different modes of action in different parts of the world (Singh, 2006). Loss of efficacy to new herbicides recommended recently has made the task of managing herbicide resistant *P. minor* biotypes more daunting. Kuk and Burgos (2007) reported that one diclofop-resistant biotype of ryegrass (*Lolium multiflorum*) was also cross resistant to ALS inhibitor mesosulfuron-methyl, chlorsulfuron, imazamox and sulfometuron. Decreased control of *P. minor* with tank mix of sulfosulfuron+metsulfuron and mesosulfuron + iodosulfuron was also observed (Walia, 2008). Continuous use of graminicides also resulted in shift of weed flora with the dominance of broadleaf weeds. Under these conditions, a new herbicide, is required to control broad-spectrum of weeds including *P. minor*. AE F130060 03, a sulfonyl urea herbicide was found effective against diclofop-methyl susceptible and resistant biotypes of *L. multiflorum* with ample wheat safety (Bailey *et al*., 2003). Similarly, BAY MKH 6561, a sulfonyl aminocarbonyl-triazolinone herbicide controlled annual grasses and selected broadleaf weeds in wheat (Geier *et al*., 2001). The present study was, thus, aimed at evaluating the efficacy of AE F130060 and MKH 6561 against mixed weed flora of wheat.

Field studies were carried out during 2007-08 using BAY AE F130060 (2.3% WG)+ MKH 6561 (8.14% WG) in 1 : 4 ratio at 7.11 + 28.49 g/ha, 8.12+32.56 g/ha without and with 0.1% surfactant (S), MKH 6561 (70% WG) at 32.56 g/ha alone and with 0.1% S, another formulation of AE F13006 [3% OD (oil dispersible)] at 8.12 g/ha without and with 0.1% S were compared with premix of mesosulfuron (3% WDG)+iodosulfuron (0.6% WDG) (Atlantis) at 14.4 g/ha+0.05% S, sulfosulfuron (75 % WG)+metsulfuron (5% WG) (Total) 16 g/ha with 0.1% S, two hand weedings [30 and 60 days after sowing (DAS)] and weedy check. Wheat cv. WH 711 was planted on 28 November 2007 at a row spacing of 20 cm in a plot size of 5.0 x 4. 0 m with three replications arranged in a randomized block design. The soil of the experimental field was sandy loam in texture, low in OC and available N, medium in P_2O_5 and high in K_2O with a pH of 8.3. Basal application of P_2O_5 and half of N was applied at sowing and the remaining half of N was applied after first irrigation. Experimental field was dominated by *P. minor*; *Avena ludoviciana* was also present but not significant. Among the broadleaf weeds, *Medicago denticulata, Lathyrus aphaca, Anagallis arvensis, Convolvulus arvensis, Vicia sativa, Chenopodium album* and *Coronopus didymus* were present in decreasing order of dominance. Herbicides were applied 50 DAS with a backpack sprayer fitted with three flat fan nozzles delivering 500 l water volume/ha. Data on visual mortality of weeds, their fresh weight and population were recorded five weeks after spraying. Plant height of *P. minor*, wheat, wheat tillers per running metre at harvest and wheat yield after threshing at 9% moisture were recorded. Data were subjected to ANOVA using SPSS. Planting of sorghum and mungbean was done after wheat harvest to study herbicide persistence.

Highest mortality of *P. minor* was recorded with tank mix application of AE F130060+MKH 6561 at 8.12+32.56 g/ha and sulfosulfuron+metsulfuron 16 g/ha with surfactant (Table 1), which was statistically

Table 1. Effect of different treatments on weeds, wheat yield attributes and yield

Treatments	Weed mortality (%)		Weed population (No./m²)		Weeds FW Total (g/m²)	Plant height (cm)		Wheat tillers (No./m.r.l)	Wheat yield (kg/ha)
	Grasses	BLW	Grasses	Total		Wheat	*P. minor*		
AEF 130060+MKH 6561 7.11+28.49 g+surf	97^{a}	95^{a}	3^{e}	9^{b}	37^{c}	80^{a}	34^{b}	98^{a}	3850^{a}
AEF 130060+MKH 6561 7.11+28.49 g	68^{c}	88^{b}	27^{bc}	50^{ab}	230^{b}	82^{a}	105^{a}	88^{a}	3617^{ab}
AEF 130060+MKH 6561 8.12+32.56 g+surf	100^{a}	97^{a}	2^{e}	4^{b}	18^{c}	78^{a}	35^{b}	99^{a}	4033^{a}
AEF 130060+MKH 6561 8.12+32.56 g	73^{bc}	90^{a}	19^{cde}	42^{ab}	207^{b}	81^{a}	105^{a}	98^{a}	3708^{ab}
AEF 130060 8.12 g+surf	90^{ab}	92^{a}	9^{cde}	20^{b}	85^{c}	79^{a}	70^{ab}	98^{a}	3617^{ab}
AEF 130060 8.12 g	60^{c}	88^{b}	29^{bc}	52^{ab}	250^{b}	83^{a}	104^{a}	95^{a}	3458^{ab}
MKH 6561 32.56+surf	80^{abc}	87^{b}	24^{cd}	52^{ab}	90^{c}	82^{ab}	99^{a}	95^{a}	3733^{ab}
MKH 6561 32.56 g	38^{d}	87^{b}	44^{ab}	80^{a}	251^{b}	80^{a}	102^{a}	95^{a}	3375^{ab}
Meso+Iodosulfuron 14.4 g	93^{ab}	98^{a}	8^{cde}	12^{b}	75^{c}	82^{a}	34^{ab}	89^{a}	3775^{a}
Sulfo+Metsulfuron 16 g	100^{a}	97^{a}	0^{e}	13^{b}	56^{c}	78^{a}	0^{c}	90^{a}	3869^{a}
HW 2 (30 and 60 DAS)	93^{ab}	97^{a}	4^{de}	13^{b}	18^{c}	81^{a}	93^{a}	98^{a}	3888^{a}
Weedy check	0^{e}	0^{c}	52^{a}	75^{a}	458^{a}	80^{a}	111^{a}	82^{b}	2858^{b}

Alphabets followed by same superscript in the column are statistically similar at 5% level of significance.

similar to AE F130060+MKH 6561 at 35.6 g/ha, two hand weedings, mesosulfuron+iodosulfuron at 14.4 g/ha and AE F130060 at 8.12 g with surfactant. MKH 6561 with and without surfactant or its tank mix application with AE F130060 without surfactant provided lower mortality of *P. minor*. All the herbicidal treatments provided more than 87% control of broadleaf weeds; control was significantly more with Atlantis (mesosulfuron+iodosulfuron), Total (sulfosulfuron+ metsulfuron) and tank mix application of AE F130060 + MKH 6561 when used with surfactant (Table 1). Similarly, two hand weedings provided 97% control of broadleaf weeds and proved superior to MKH 6561 at 32.56 g/ha used alone with or without surfactant, MKH 6561+AE F130060 at 35.6 g without surfactant and AE F130060 alone at 8.12 g/ha without surfactant. *P. minor* population was highest in weedy plot, followed by alone application of MKH 6561 and AE F130060 alone or their tank mix application when applied without surfactant (Table 1). Grassy weed population with tank mix application of AE F130060+MKH 6561 without surfactant was significantly less than weedy plots, but significantly higher compared to addition of surfactant to these mixtures. Total weed population in plots treated with MKH 6561 at 32.56 g without surfactant was similar to weedy plots. Lowest weed population (grassy+broadleaf) was recorded with tank mix applications of AE F130060+MKH 6561 used with surfactant followed by premix applications of mesosulfuron+iodosulfuron, sulfosulfuron+metsulfuron and two hand weedings. Total fresh weight of weed also reflected same trend as that of weed population (Table 1). Application of AE F130060+MKH 6561, alone application of AE F130060 or MKH 6561 without surfactant resulted in significantly higher fresh weight compared to use of surfactant with these treatments. Plant height of wheat was reduced after spraying; the reduction was more where surfactant was used with tank mix application of AE F130060+MKH 6561 followed by Atlantis and Total herbicides, but plants recovered later on and no difference in height was recorded after 90 days of spraying (Table 1). Maximum plant height of *P. minor* was recorded under weedy condition followed by tank mix application of AE F130060+MKH 6561 without surfactant, alone application of MKH 6561 with or without surfactant and AE F130060 when used without surfactant. There was complete mortality of *P. minor* with pre-mix application of Total, some plants emerged after the application of Atlantis and tank mix application of AE F130060+MKH 6561 at 35.6 g or 40.68 g/ha with surfactant. There was no significant difference in tillers number with different treatments except weedy check (Table 1). Highest wheat yield was recorded with tank mix application of AE F130060+MKH 6561 at 40.68 g/ha+0.1% S, followed by two hand weedings, application of Total at 16 g/ha and tank mix of AE F130060+MKH 6561 at 35.6 g/ha+0.1% S (Table 1). Weedy plots yielded 40% less compared to tank mix of AE F130060+MKH 6561 at 8.12+32.56 g plus 0.1% surfactant.

Premix application of Total at 16 g/ha killed all the weeds, but also suppressed wheat, though it recovered later on and finally there was no adverse effect on yield or yield parameters of wheat. Tank mix application of AE F130060+MKH 6561 with surfactant was very effective against *P. minor*, *M. denticulata, R. dentatus* and suppressed other broadleaf weeds too. Surfactant significantly improved the efficacy of mixture compared to no surfactant use, but the tank mixture was also more suppressive to crop; however, wheat recovered later on with no growth or yield penalty. Addition of surfactant to AE F130060 tank mix applications with several broadleaf herbicides improved its efficacy against weeds without adversely affecting wheat selectivity (Crooks *et al*., 2003; Bailey *et al*., 2003; King and Hagood, 2005). The OD formulation of AE F130060 at 8.12 g/ha+01.% S provided 90% control of grassy weeds, but was inferior to tank mix application of AE F130060+MKH 6561with 0.1% S, though had no crop suppression as recorded with AE F130060+MKH 6561with 0.1% S. AE F130060 OD formulation suppressed weeds, but was not as effective as its WG formulation tank mix application with MKH 6561. Though it was good against *Convolvulus arvensis*, poor efficacy was observed on *Chenopodium album* and other broadleaf weeds. Similarly, MKH 6561 used alone at 32.56 g/ha+0.1% S was less effective against broad-spectrum weeds compared to its tank mix application with AE F130060. MKH 6561 with or without surfactant at 32.56 g/ha had no adverse effect on wheat. Geier *et al*. (2001) reported that MKH 6561 under greenhouse conditions was safe to wheat upto 45 g/ha. AE F130060 at 8.12 g/ha+MKH 6561at 32.56 g/ha +0.1% S provided similar weed control to that of already recommended herbicides, Atlantis and Total and produced higher grain yield of wheat, additionally it had the advantage of not leaving any soil residues affecting sorghum or mungbean planted after wheat harvest. Emergence of sorghum in wheat plots treated with Total at 16 g/ha was adversely affected followed by Atlantis at 14.4 g/ha; however, the effect was less visible on mungbean. None of the herbicides except Total and Atlantis had residual effect when sorghum and mungbean were planted after wheat harvest (data not presented). The mixture of AE F130060 and MKH 6561 with surfactant need evaluation against resistant biotypes of *P. minor* and also under different growing conditions at farmers' field against complex weed flora of wheat to derive logical conclusions.

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