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# Effect of tillage and pre-mix application of herbicides on weed growth and productivity of late-sown wheat

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**ABSTRACT**

A field experiment was conducted during the *Rabi* (winter) season of 2016-17 at Agricultural Farm, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal to study the effect of tillage and weed management on weed growth, productivity and profitability of wheat. The experiment was laid out in a split-plot design with three replications comprising of two tillage and six weed management practices in main and sub plots, respectively. Results showed that zero tillage registered significantly lower density of grasses and total weeds as compared to conventional tillage. Among the weed management practices, weed free plot registered significantly higher grain yield (3.6 t/ha), which was statistically at par with the application of both the doses (25 and 35 g/ha) of sulfosulfuron ethyl + metsulfuron-methyl and clodinafop-propargyl + metsulfuron-methyl 96 g/ha. Zero tillage with the application of sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha fetched the highest net return (₹ 40,119/ha) and return per rupee invested (2.3), which was comparable with sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 25 g/ha. Thus, in late sown wheat, zero tillage along with pre-mix application of sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 25-35 g/ha and clodinafop-propargyl + metsulfuron-methyl 96 g/ha at 30 DAS appeared to be promising for effective weed control and higher productivity as well as profitability.

Wheat (*Triticum aestivum*) is the second most important crop in India whereas in West Bengal, its share of total cultivated land is very limited. Total area and production of wheat during 2017-18 has been reported to be 29.58 million ha and 99.70 million tonnes, respectively with a productivity of 3.3 t/ha in India (DAC&FW, 2018). Zero tillage is becoming popular because of its suitability in rice-wheat cropping system. Diversified weed flora causes severe yield loss in wheat. Pre-mixed broad-spectrum herbicide is cost-effective against complex weed flora. Hence, the present experiment was conducted to study the effect of tillage and weed management on weed growth, productivity and profitability of late sown wheat in the sub-humid red and lateritic agro-ecological zone of the tropics using different doses of premix herbicide *i.e.* sulfosulfuron-ethyl + metsulfuron-methyl and clodinafop-propargyl + metsulfuron-methyl.

The field experiment was conducted during *Rabi* (winter) season of 2016-17 in the Agricultural Farm of Institute of Agriculture, Visva-Bharati, Sriniketan (located at 23$^0$40.105′ N latitude and 87$^0$39.521′ E longitude at an altitude of 56 m above the mean sea level), West Bengal, which is situated in the sub-humid red and lateritic agro-ecological zone of the tropics. The soil was sandy loam in texture, slightly acidic in reaction ($p^H$ 5.8) and low in organic carbon (0.42%), available nitrogen (133.4 kg/ha) and extractable potassium (123.7 kg/ha) whereas, medium in available phosphorous (11.5 kg/ha).

Two tillage practices, *viz.* zero tillage (ZT) and conventional tillage (CT) in main plot and six weed management practices, *viz.* sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 25 g/ha, sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha, clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 80 g/ha, clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 96 g/ha, weed free (two hand weeding at 25 and 40 DAS) and weedy check in sub plot, were evaluated in a split plot design with three replications. The wheat variety *'HD 2824 (Poorva)'* was sown on

11th December 2016 with a seed rate of 120 kg/ha for both zero and conventional tilled plots. Sowing was done mechanically with the help of national zero till ferti-cum-seed drill machine by maintaining a row to row spacing of 20 cm. The recommended package of practices was imposed uniformly during the course of experiment to all the treatments. The herbicides were sprayed using battery operated knapsack sprayer fitted with a flat fan nozzle at a spray volume of 500 L of water per hectare at 30 days after sowing. Density and biomass of different weeds were taken by placing the quadrat of 50 × 50 cm randomly in the sampling area. Urea and complex fertilizer (10-26-26) were the sources of nutrients applied at a recommended dose of 120:60:60 N, P and K kg/ha, respectively. Half amount of nitrogen, full dose of phosphorus and potassium was applied at the time of sowing and remaining nitrogen was applied through urea in two equal splits at crown root initiation (CRI) stage and booting stage. The field was kept moist throughout the crop growing season by giving surface irrigation. One pre sowing irrigation was given before the wheat seeding for uniform germination. Total number of irrigations including pre sowing irrigation was six, whereas the rest five irrigations were applied at CRI, tillering, late jointing, flowering and dough stages of crop growth.

The data recorded from the experiment were subjected to the analysis of variance (ANOVA) as applied to split-plot design. The significance of different sources of variation was tested with the help of 'F' test at the 5% level of significance. Data showing wide variation and having the value zero in weed density and biomass, were subjected to square root transformation [$\sqrt{x+0.5}$] before statistical analysis.

**Effect on weeds**

*Digitaria sanguinalis* with 13.2% relative density (RD), *Echinochloa colona* (2.6% RD) among the grasses and *Polygonum plebeium* (63.0% RD), *Gnaphalium indicum* (12.5% RD), and *Spilanthes calva* (8.7% RD) among the broad-leaved were the predominant weeds found in the experimental field. In weedy check, the broad-leaved weeds comprised of 84.2% density and 69.5% biomass, whereas those of grassy weed was 15.8 and 30.5% of total weed, respectively (**Table 1**).

Zero tillage registered significantly lower density of grassy and total weeds (27 and 17%, respectively) as compared to conventional tillage. Crust formation in absence of tillage in zero tilled plot, may be the main reason behind the reduction in emergence of grassy weeds. However, the biomass of grassy, broad-leaved and total weeds did not vary significantly between tillage practices. Among the weed management practices, sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha recorded significantly the lowest density and biomass of grassy, broad-leaved and total weeds and was found at par with sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 25 g/ha except grassy weed density. Ready mixed application of sulfosulfuron + metsulfuron executed an excellent control of both *D. sanguinalis* and *P. plebeium*, which were found predominant in weedy check plot. Application of clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 96 g/ha was also statistically at par with sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha with respect to density and biomass of broad-leaved weed. This could be explained by the evidence that better control of *P. plebeium* and *G. indicum* was obtained due to the presence of metsulfuron in ready mix product. Similar results were obtained from Tiwari *et al.* (2016) and Meena *et al.* (2019).

**Effect on crop**

The number of grains/spike, test weight, no. of spikes/m$^2$, grain and straw yield and harvest index of wheat didn't vary between tillage practices (**Table 2**). But those varied significantly among the weed management practices except test weight. This result

**Table 1. Effect of tillage and weed management on density and biomass of weeds in wheat**

| Treatment | Weed density (no/m$^2$) at 45 DAS | | | Weed biomass (g/m$^2$) at 45 DAS | | |
|---|---|---|---|---|---|---|
| | Grassy | BLW | Total | Grassy | BLW | Total |
| *Tillage practice* | | | | | | |
| Zero tillage | 3.55 (12.09) | 9.77 (94.88) | 10.37 (106.97) | 1.71 (2.41) | 2.63 (6.42) | 3.05 (8.79) |
| Conventional tillage | 4.13 (16.59) | 10.62 (112.26) | 11.39 (129.17) | 1.86 (2.96) | 2.69 (6.74) | 3.19 (9.68) |
| LSD (p=0.05) | 0.51 | NS | 0.94 | NS | NS | NS |
| *Weed management practice* | | | | | | |
| Sulfosulfuron-ethyl + MSM 25 g/ha | 2.99 (8.42) | 10.84 (117.09) | 11.23 (125.64) | 0.90 (0.32) | 2.22 (4.41) | 2.29 (4.73) |
| Sulfosulfuron-ethyl + MSM 35 g/ha | 2.34 (4.98) | 9.68 (93.20) | 9.94 (98.40) | 0.87 (0.25) | 2.09 (3.87) | 2.15 (4.14) |
| Clodinafop-propargyl + MSM 80 g/ha | 4.97 (24.15) | 11.39 (129.26) | 12.42 (153.69) | 2.43 (5.42) | 2.71 (6.86) | 3.60 (12.43) |
| Clodinafop-propargyl + MSM 96 g/ha | 4.46 (19.42) | 11.10 (122.74) | 11.96 (142.61) | 1.90 (3.12) | 2.44 (5.43) | 3.01 (8.55) |
| Weed free (hand weeding at 25 and 40 DAS) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) | 0.71 (0.00) |
| Weedy check | 7.59 (57.05) | 17.43 (303.37) | 19.00 (360.49) | 3.89 (14.65) | 5.81 (33.24) | 6.96 (47.97) |
| LSD (p=0.05) | 0.57 | 1.54 | 1.53 | 0.30 | 0.41 | 0.42 |
| Interaction | S | S | S | S | S | S |

*Figures within parentheses indicate original values and the data were transformed to $\sqrt{x+0.5}$ before analysis; MSM = Metsulfuron-methyl

**Table 2. Effect of tillage and weed management on yield component, yield and economics of wheat**

| Treatment | No. of grains/ spike | Test weight (g) | No. of spikes/ $m^2$ | Grain yield (t/ha) | Straw yield (t/ha) | Harvest index (%) | Cost of cultivation (`/ha) | Gross return (`/ha) | Net returns (`/ha) | Returns/ rupee invested |
|---|---|---|---|---|---|---|---|---|---|---|
| *Tillage practice* | | | | | | | | | | |
| Zero tillage | 42.3 | 41.0 | 257 | 3.3 | 4.6 | 41.0 | 33725 | 67039 | 33314 | 2.0 |
| Conventional tillage | 40.6 | 40.9 | 250 | 3.1 | 4.5 | 40.7 | 43765 | 64581 | 20816 | 1.5 |
| LSD (p=0.05) | NS | NS | NS | NS | NS | NS | - | NS | 4918 | 0.1 |
| *Weed management practice* | | | | | | | | | | |
| Sulfosulfuron-ethyl + MSM 25g/ha | 42.3 | 41.7 | 253 | 3.3 | 4.6 | 41.9 | 36023 | 68182 | 32159 | 1.9 |
| Sulfosulfuron-ethyl + MSM 35 g/ha | 44.4 | 41.8 | 278 | 3.5 | 4.8 | 42.2 | 36249 | 71486 | 35237 | 2.0 |
| Clodinafop-propargyl + MSM 80 g/ha | 41.9 | 40.1 | 242 | 3.1 | 4.4 | 41.4 | 37026 | 64086 | 27060 | 1.8 |
| Clodinafop-propargyl + MSM 96 g/ha | 43.7 | 41.9 | 260 | 3.3 | 4.8 | 41.1 | 37542 | 68378 | 30836 | 1.9 |
| Weed free (hand weeding at 25 and 40 DAS) | 41.2 | 41.2 | 285 | 3.6 | 4.9 | 42.8 | 50815 | 73571 | 22756 | 1.5 |
| Weedy check | 35.1 | 39.4 | 204 | 2.3 | 4.1 | 35.4 | 34815 | 49156 | 14341 | 1.4 |
| LSD (p=0.05) | 5.5 | NS | 30 | 0.4 | 0.5 | 2.5 | - | 5140 | 5140 | 0.2 |
| Interaction | S | NS | S | S | S | S | - | S | S | S |

MSM = Metsulfuron-methyl

were in agreement with Jat *et al.* (2013). Weed free plot registered significantly the highest grain yield (3.6 t/ha), straw yield (4.9 t/ha) and harvest index (42.8%), which was statistically on par with the application of sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha, sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 25 g/ha and clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 96 g/ha. While, weedy check registered significantly the lowest number of grains/ear (35.1), no. of ears/$m^2$ (204), grain yield (2.3 t/ha), straw yield (4.1 t/ha) and harvest index (35.4%). Consistent with our findings, application of metsulfuron + clodinafop herbicide in zero tilled wheat resulted in higher grain and straw yields (Singh *et al.* 2017). The weed infestation in the weedy check, took away the resources like water, nutrient, space, sunlight *etc*. Hence under stress, the crop plants could not achieve its optimum growth and development, which ultimately reduced the yield attributes and yield of wheat. These results were in conformity with those of Meena *et al.* (2019).

### Effect on economics

Zero tillage incurred the lowest cost of cultivation (₹ 33,725/ha) and fetched the highest gross return (₹ 67,039/ha) as compared to conventional tillage (cost of cultivation and gross return are ₹ 43,765 and 64,521/ ha, respectively). Among weed management practices, the highest cost of cultivation was incurred in weed free check. Net return and return per rupee invested from wheat cultivation were significantly influenced by tillage and weed management practices (**Table2**). Zero tillage registered the highest net return (₹ 33,314/ha) and return per rupee invested (2.0). Similar results were also obtained by Kumar *et al.* (2013). Irrespective of tillage practices, sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha, fetched the highest net return (₹ 35,237/ha) and return per rupee invested (2.0) and remained at par with sulfosulfuron ethyl 75% + metsulfuron-methyl 5% WG 25 g/ha and clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 96 g/ha. Interaction amongst tillage and weed management practices revealed that zero tillage with the application of sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG 35 g/ha fetched the highest net return (₹ 40,119/ ha) and return per rupee invested (2.3) in wheat.

Thus, it may be concluded that in late sown wheat, zero tillage along with pre-mix application of either sulfosulfuron-ethyl 75% + metsulfuron-methyl 5% WG25-35 g/ha or clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 96 g/ha at 30 DAS provided effective weed management and registered higher productivity as well as profitability in lateritic soil of West Bengal.

## REFERENCES

DAC&FW. 2018. *Agricultural statistics at a glance.* 2018. Government of India, Directorate of Economics & Statistics, DAC&FW.Pp. 78.

Jat RK, Banga RS and Yadav A. 2013. Resource conservation techniques and pendimethalin for control of weeds in durum wheat cultivars. *Indian Journal of Weed Science* **45**(2): 93–98.

Kumar V, Saharawat YS, Gathala MK, Jat AS, Singh SK, Chaudhary N, and Jat ML. 2013. Effect of different tillage and seeding methods on energy use efficiency and productivity of wheat in the Indo-Gangetic Plains. *Field Crops Research* **142**: 1–8.

Meena V, Kaushik MK, Dotaniya ML, Meena BP and Das H. 2019. Bio-efficacy of ready-mix herbicides on weeds and productivity in late-sown wheat. *Indian Journal of Weed Science* **51**(4): 344–351.

Tiwari A, Verma VK, Tiwari A and Sharma JD. 2016. Effect on growth, yield and economics of wheat (*Triticum aestivum L.*) as affected by different herbicides. *Research in Environment and Life Sciences* **9**(4): 490-492.

Singh P, Kewat ML, Sharma AR, Sapre N. 2017. Tillage and weed management effect on productivity of wheat under soybean-wheat-greengram cropping system in conservation agriculture. *Indian Journal of Weed Science* **49**(3): 226–230.