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**Short communication**

# Management of complex weed flora in chickpea

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Chickpea (*Cicer arietinum* L.) is an important winter season pulse crop and a key source of protein. In India, chickpea is grown over an area of 8.52 million ha with production of 8.83 million tonnes and average productivity of 1.04 t/ha (Anonymous 2014). Among various barriers, poor weed management in chickpea is one of the most important yield limiting factors. Chickpea, being slow in its early growth and short stature plant, is highly susceptible to weed competition and often considerable losses may occur if weeds are not controlled at proper time. Weed infestation in winter pulses has been reported to offer serious competition and causes yield reduction to the extent of 75% in chickpea (Chaudhary *et al*. 2005). A critical period of 30 to 60 days is considered to be the crucial for crop-weed competition in chickpea (Kumar and Singh 2010). Weed management with herbicides is an effective, quick in action, and time saving method. Herbicide treatment gave 50-64% weed control with considerable increase in yield (Bhalla *et al*. 1998). Pendimethalin is extensively used as PE herbicide for weed management in chickpea field, but the efficacy of pendimethalin fluctuates according to the soil type, moisture regime and type of weed flora, and there is no recommended herbicide for chickpea. Therefore, there is a need to study the efficacy of non-recommended pre and PoE herbicides either alone or in combination for efficient weed management in chickpea in Chhattisgarh region.

A field experiment was conducted during *Rabi* season of 2013-14 at the Instructional Cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The soil of experimental field was clayey in texture, low in nitrogen, medium in phosphorus and high in potassium contents with neutral pH. The experiment was laid out in randomized block design with 11 tratments in three replications. The chickpea variety *'JG-130'* was grown as test crop. The crop was sown on 25$^{th}$ November by seed cum fertilizer drill in rows at 30 cm apart with seed rate of 80 kg/ha and harvested in second week of March. A basal application of 20 kg N, 50 kg $P_2O_5$ and 30 kg/ha $K_2O$ was given uniformly through DAP and MOP in all the experimental plots. After sowing of the seed immediately a light irrigation was given to the crop for uniform germination. Herbicides were applied as PE, early PoE and PoE by using knapsack sprayer fitted with flat fan nozzle by mixing in 500 liter of water/ha as per treatments. All the growth characters *viz.* plant height, number of branches, dry matter accumulation, number of pods, seed yield and stover yield, harvest index and weed index of chickpea crop were recorded and economics in terms of net return and benefit cost ratio were calculated with prevailing rates. Phytotoxicity of herbicides on chickpea was observed by quantitative visual assessment at 1, 3, 7 and 10 days after spraying of herbicides by using rating scale 0-10. Dehydrogenase activity of experimental field was measured by using UV/VIS Spectrophotometer with the wavelength of 485 nm. The total weed density and total dry matter production by weeds were also recorded and subjected to square root $\sqrt{x+0.5}$ transformation and statistically analyzed.

The dominant weed flora of the experimental field comprised of *Medicago denticulata* (41.9%), *Convolvulus arvensis* (23.7%), *Chenopodium album* (5.1%), *Melilotus indica* (5.0%), *Brachiaria mutica* (12.7%) and some other weeds (11.6%).

Different weed management practices significantly influenced the density and dry matter production of total weeds. Total and species wise weed density and dry matter production of *Medicago denticulata, Convolvulus arvensis, Chenopodium album, Melilotus indica* and *Brachiaria mutica* and some other weed species were recorded maximum under the control plot and minimum was observed under treatment of hand weeding twice at 25 and 45 DAS, followed by metribuzin at 250 g/ha as post-emergence (PoE) and oxyfluorfen + metribuzin at 125 + 350 g/ha as pre-emergence (PE). Similar results were observed by Patel *et al.* (2006), Kumar

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*et al*. (2008), Sadiq *et al.* (2011). Minimum weed index was registered under hand weeding twice at 25 and 45 DAS, followed by oxyfluorfen + metribuzin at 125 + 350 g/ha as PE and metribuzin at 250 g/ha as PE and maximum weed index (74.4%) was noticed under control plot (Table 1). Results revealed that the hand weeding twice at 25 and 45 DAS and herbicide combination of oxyfluorfen + metribuzin at 125 + 350 g/ha as PE were most effective in reducing density and dry weight of weeds with the weed control efficiency of 90.4 and 74.3%, respectively.

The significantly higher growth characters *viz*. plant height (cm), number of branches, dry matter accumulation (g/plant) were recorded significantly higher in hand weeding twice at 25 and 45 DAS, followed by the oxyfluorfen + metribuzin at 125 + 350 g/ha as PE and metribuzin at 250 g/ha as PE. Similar findings have been reported by Pedde *et al*. (2013), Tiwari and Meena (2014).

Among the herbicides, PE application of pendimethalin at 1000 g/ha, pendimethalin at 1250 g/ ha, pendimethalin at 1500 g/ha, pendimethalin (extra) at 1000 g/ha, oxyfluorfen at 125 g/ha, metribuzin at 250 g/ha and oxyfluorfen + metribuzin at 125 + 350 g/ha were found to be safe herbicides on chickpea and phytotoxic symptoms were not seen throughout its growth period from germination to harvest. Whereas, oxyfluorfen at 125 g/ha and metribuzin at 250 g/ha when applied as early PoE and PoE, respectively, showed adverse effects on chickpea crop. Light yellow discoloration on leaves was observed in 3 days after spraying of oxyfluorfen at 125 g/ha as early PoE and metribuzin at 250 g/ha as PoE, and scorching was also observed with the spraying of metribuzin at 250 g/ha applied as PoE. However, these symptoms vanished and crop was normal by 20 days after herbicide application.

Yield attributes of chickpea *viz.* number of pods/ plant, number of seeds/pod, 100 seed weight were recorded highest under hand weeding twice at 25 and 45 DAS, followed by oxyfluorfen + metribuzin at 125 + 350 g/ha as PE, but number of seeds/ pod and 100 seed weight did not influence significantly due to various weed management practices.

Significantly highest seed and stover yield registered under the treatment of hand weeding twice at 25 and 45 DAS, however, it was at par with the treatment of oxyfluorfen + metribuzin at 125 + 350 g/ ha as PE and metribuzin at 250 g/ha as PE. The minimum seed yield was recorded under control treatment. Among other herbicidal treatments, combination of oxyfluorfen + metribuzin at 125 + 350

**Table 1. Density and dry matter accumulation of total weeds as influenced by different weed management practices at different growth stages**

| Treatment | Dose (g/ha) | Density of total weeds (no./m$^2$) | | | Dry matter of total weeds (g/m$^2$) | | | Weed control efficiency (%) |
|---|---|---|---|---|---|---|---|---|
| | | 40 DAS | 60 DAS | At harvest | 40 DAS | 60 DAS | At harvest | |
| Pendimethalin as pre-emergence | 1000 | 9.83 (96.3) | 11.1 (123.0) | 12.1 (145.3) | 7.10 (49.9) | 11. 8 (138.4) | 15.8 (249.7) | 34.6 |
| Pendimethalin as pre-emergence | 1250 | 8.72 (75.7) | 9.82 (96.0) | 11.26 (126.3) | 6.43 (40.8) | 10.9 (118.7) | 14.4 (205.8) | 46.1 |
| Pendimethalin as pre-emergence | 1500 | 8.45 (71.0) | 9.04 (81.3) | 10.82 (117.0) | 6.02 (35.7) | 10.5 (109.6) | 13.18 (173.3) | 54.6 |
| Pendimethalin (extra) as pre-emergence | 1000 | 10.9 (118.3) | 11.5 (133.0) | 13.1 (171.3) | 7.37 (53.8) | 12.6 (158.8) | 16.5 (274.1) | 28.3 |
| Oxyfluorfen as pre-emergence | 125 | 9.51 (90.0) | 10.1 (102.7) | 11.7 (137.0) | 6.57 (42.9) | 11.3 (126.3) | 14.94 (223.0) | 41.6 |
| Metribuzin as pre-emergence | 250 | 7.95 (62.7) | 8.64 (74.3) | 9.40 (88.0) | 5.28 (27.4) | 9.51 (90.1) | 12.3 (152.0) | 60.2 |
| Oxyfluorfen + metribuzin as pre-emergence | 125+350 | 7.25 (52.3) | 7.96 (63.0) | 8.52 (72.3) | 4.72 (21.8) | 7.68 (58.4) | 9.91 (98.2) | 74.3 |
| Oxyfluorfen as early ost-emerence | 125 | 11.31 (128.0) | 12.61 (158.7) | 13.8 (192.3) | 7.63 (58.1) | 12.8 (166.1) | 16.7 (278.3) | 27.2 |
| Metribuzin as post-emergence | 250 | 7.02 (49.0) | 7.77 (60.0) | 8.40 (70.0) | 4.35 (18.1) | 7.76 (58.2) | 9.87 (97.0) | 74.6 |
| Control | - | 13.43 (182.3) | 15.2 (233.3) | 16.5 (275.3) | 10.5 (110.6) | 15.8 (250.9) | 19.5 (382.2) | - |
| Hand weeding twice at 25 and 45 DAS | - | 3.56 (12.3) | 4.49 (19.7) | 5.49 (29.6) | 2.43 (5.4) | 4.22 (17.3) | 6.09 (36.6) | 90.4 |
| LSD(P=0.05) | | 1.28 | 1.52 | 1.57 | 0.60 | 0.70 | 1.52 | - |

Figures in the parentheses are original values; data were transformed through $\sqrt{x+0.5}$ which are given in bold

**Table 2. Effect of weed management practices on yield attributes, yield and economics of chickpea**

| Treatment | Pods/ plant (no.) | 100 seed weight (g) | Seed yield (t/ ha) | Stover yield (t/ha) | Harvest index (%) | Weed Index (%) | Net return (x$10^3$ `/ha) | B :C ratio |
|---|---|---|---|---|---|---|---|---|
| Pendimethalin 1000 g/ha as pre-emergence | 39.8 | 25.9 | 1.09 | 1.53 | 41.1 | 38.1 | 8.60 | 1.36 |
| Pendimethalin 1250 g/ha as pre-emergence | 40.2 | 26.1 | 1.32 | 1.74 | 42.3 | 24.8 | 15.43 | 1.63 |
| Pendimethalin 1500 g/ha as pre-emergence | 44.1 | 26.3 | 1.38 | 1.79 | 42.9 | 21.7 | 16.76 | 1.68 |
| Pendimethalin (extra) 38.7% CS at 1000 g/ha as pre-emergence | 37.4 | 26.2 | 1.08 | 1.51 | 40.4 | 38.7 | 6.25 | 1.24 |
| Oxyfluorfen 125 g/ha as pre-emergence | 40.0 | 26.0 | 1.24 | 1.69 | 41.9 | 29.5 | 13.64 | 1.58 |
| Metribuzin 250 g/ha as pre-emergence | 45.2 | 26.4 | 1.51 | 1.94 | 43.2 | 14.0 | 22.11 | 1.95 |
| Oxyfluorfen + metribuzin 125+350 g/ha as pre-emergence | 47.8 | 26.7 | 1.68 | 2.12 | 43.5 | 4.7 | 25.88 | 2.05 |
| Oxyfluorfen 125 g/ha early post-emergence | 31.2 | 25.7 | 0.82 | 1.32 | 38.5 | 53.2 | 1.12 | 1.05 |
| Metribuzin 70 WP at 250 g/ha as post-emergence | 27.9 | 25.2 | 0.66 | 1.09 | 37.9 | 62.3 | -3.38 | 0.86 |
| Control | 25.8 | 25.2 | 0.45 | 0.76 | 37.3 | 74.4 | -8.87 | 0.60 |
| Hand weeding twice at 25 and 45 DAS | 50.4 | 27.1 | 1.76 | 0.214 | 43.8 | - | 25.46 | 1.93 |
| LSD (P=0.05) | 6.0 | NS | 0.25 | 0.32 | 4.1 | - | - | - |

g/ha as PE recorded 73.10 % higher seed yield over control plot. The maximum harvest index (43.80%) was estimated under hand weeding twice at 25 and 45 DAS, but, it was at par with the treatment of oxyfluorfen + metribuzin at 125 + 350 g/ha as PE, metribuzin at 250 g/ha as PE, pendimethalin at 1500 g/ha as PE, pendimethalin at 1250 g/ha as PE, oxyfluorfen at 250 g/ha as PE, pendimethalin at 1000 g/ha as PE and pendimethalin (extra) at 1000 g/ha as PE, respectively and minimum was recorded under control plot. Similar results were observed by Chaudhary *et al.* (2005), Hassan and Khan (2007) (Table 2).

Dehydrogenase activity (ìg TPF/h/g soil) of chickpea field was influenced significantly due to different weed management practices. At 50 DAS, significantly higher dehydrogenase activity was measured under the treatment of control plot, which was at par with the treatment of hand weeding twice at 25 and 45 DAS, pendimethalin at 1000 g/ha as PE, pendimethalin at 1250 g/ha as PE and pendimethalin (extra) at 1000 g/ha as PE, respectively. At harvest, significantly higher dehydrogenase activity was measured under the treatment of control plot, which was at par with treatment of hand weeding twice at 25 and 45 DAS, pendimethalin at 1000 g/ha as PE, pendimethalin at 1250 g/ha as PE, pendimethalin (extra) at 1000 g/ha as PE, pendimethalin at 1500 g/ha as PE, metribuzin at 250 g/ha as PE, oxyfluorfen at 125 g/ha as PE, oxyfluorfen + metribuzin at 125 + 350 g/ha as PE, respectively. The minimum dehydrogenase activity was measured under oxyfluorfen at 125 g/ha as early PoE followed by metribuzin at 250 g/ha as PoE. The minimum dehydrogenase activity under these treatments might be due to herbicidal toxic effects on microbial population (Table 3).

**Table 3. Dehydrogenase activity (ìg TPF/h/g soil) of rhizosphere soil as affected by weed management practices of chickpea**

| Weed management practices | Dose (g/ha) | Dehydrogenase activity (µg TPF/h/g soil) | |
|---|---|---|---|
| | | 50 DAS | At harvest |
| Pendimethalin as PE | 1000 | 62.3 | 25.9 |
| Pendimethalin as PE | 1250 | 61.1 | 25.4 |
| Pendimethalin as PE | 1500 | 59.2 | 24.7 |
| Pendimethalin (extra) as PE | 1000 | 60.6 | 25.1 |
| Oxyfluorfen as PE | 125 | 57.6 | 23.9 |
| Metribuzin as PE | 250 | 58.3 | 24.1 |
| Oxyfluorfen+ Metribuzin as PE | 125+350 | 57.2 | 23.4 |
| Oxyfluorfen as early PoE | 125 | 52.7 | 21.4 |
| Metribuzin as PoE | 250 | 53.6 | 22.1 |
| Control | - | 68.3 | 28.1 |
| Hand weeding twice at 25 and 45 DAS | - | 64.4 | 27.2 |
| LSD (P=0.05) | | 8.24 | 4.71 |

## Economics

Economics in terms of net return was recorded highest under oxyfluorfen + metribuzin at 125 + 350 g/ha as PE, followed by hand weeding twice at 25 and 45 DAS and metribuzin at 250 g/ha as PE. The highest benefit: cost ratio (2.05) recorded under the treatment of oxyfluorfen + metribuzin at 125 + 350 g/ ha as PE, followed by metribuzin at 250 g/ha as PE and hand weeding twice at 25 and 45 DAS, respectively. However, minimum gross return, net returns and benefit: cost ratio was obtained under control plot.

It may be concluded that oxyfluorfen + metribuzin at 125 + 350 g/ha as PE would be an appropriate combination of herbicides to achieve higher yield and B:C ratio of chickpea with lower density and dry weight of weeds without any phytotoxic effect on chickpea plant.

## SUMMARY

A field experiment was conducted during *Rabi* season of 2013-14 at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) to find out efficient herbicide combinations for weed management in chickpea. Further, significantly higher growth characters *viz*. plant height, number of branches, dry matter accumulation as well as yield attributes, seed yield, stover yield and harvest index were recorded under hand weeding twice at 25 and 45 DAS, which was at par with tank mix PE application of oxyfluorfen + metribuzin at 125 + 350 g/ha and registered an yield increase of 74.36 and 73.1%, respectively, over control. Metribuzin at 250 g/ha applied at 20 DAS and oxyfluorfen at 125 g/ha applied at 12 DAS showed phytotoxic effects on chickpea plants and recorded reduction in yield of 62.26 and 53.2%, respectively, over hand weeding twice at 25 and 45 DAS. Economics in terms of net return and B:C ratio recorded maximum under oxyfluorfen + metribuzin at 125 + 350 g/ha as PE. Dehydrogenase enzyme activity of experimental field was significantly maximum under control plot, followed by hand weeding twice at 25 and 45 DAS.


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