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## Effect of weed management practices on growth, yield and economics of chickpea

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**Abstract**

The field experiment conducted during *Rabi* season of the year 2017 at the Instructional Farm, Swami Vivekanand University, Sagar Madhya Pradesh. The nine weed control treatments comprising of three as pre-emergence *viz.*, Pendimethalin @ 0.75 kg *a.i.* ha<sup>-1</sup>, Oxyfluorfen @ 0.100 kg *a.i.* ha<sup>-1</sup> and Metribuzin @ 0.75 kg *a.i.* ha<sup>-1</sup> and three as post-emergence *viz.*, Imazethapyr @ 0.75 kg *a.i.* ha<sup>-1</sup>, Propaquizafop @ 0.75 kg *a.i.* ha<sup>-1</sup> and Quizalofop-ethyl @ 0.40 kg *a.i.* ha<sup>-1</sup>, hand weeding twice at 30 and 45 DAS, weed free and weedy check, were laid out in randomized block design with 3 replications. The results indicated that among herbicides, application of Pendimethalin @ 0.75 kg *a.i.* ha<sup>-1</sup> as pre-emergence recorded higher values of growth parameters *viz.*, plant height, number of branches per plant, dry weight per plant, No. of nodules and weight of nodules, yield attributes *viz.*, number of pods per plant, number of seeds per pod, test weight, biological yield/plot, seed yield/plot and straw yield/plot, straw yield (3205.60 kg ha<sup>-1</sup>), gross monetary returns (117667 Rs. ha<sup>-1</sup>), net Monetary returns (90902 Rs. ha<sup>-1</sup>) and benefit cost ratio (4.53) were recorded under application of Oxyfluorfen @ 0.100 kg *a.i.* ha<sup>-1</sup> as compared to rest of the treatments.

**Keywords:** Management, practices, economics, chickpea

**Introduction**

Chickpea is world's important pulse crop occupying third position among pulses. Among a dozen of different grain legumes under cultivation in India, chickpea is the leading crop and is grown in *Rabi* season. Chickpea is used as whole seed or split seed (dhal), flour in preparing variety of snack, raw or roasted fresh green chickpeas and straw as a livestock feed. Chickpea is free from various anti-nutritional factors and has high protein (23%), total carbohydrates (64%) and dietary fibre content (19%).

Indian subcontinent accounts for 67% of production of chickpea in the world. Chickpea is the pre dominant crop among pulses in Madhya Pradesh occupying an area of 95.39 lakh ha with production of 90.75 lakh tones and productivity 951 kg ha<sup>-1</sup> respectively (DPR, 2016-17).

Simultaneous emergence and rapid growth of weed lead to severe weed competition for light, moisture, space and nutrients resulting in drastic reduction in yield. Chickpea crop is not a competitive crop, especially when weed competition occurs at early stages (Barker, 2017). Indian Institute of Pulses Research, yield losses due to weed in chickpea varied between 29-70 per cent over the years (Anonymous, 2009). Mohammadi *et al.* (2005) reported that severe infestation of weeds caused reduction in seed yield of about 66.4 and 48.3 per cent throughout the crop growing season of chickpea. However, maximum yield to the extent of 81 to 97 per cent has also been reported by Barker (2017).

The major weeds of chickpea in irrigated area of mix cropping zone of Punjab are *Chenopodium album*, *Chenopodium murale*, *Fumaria indica*, *Rumex dentatus*, *Vicia sativa* and *Avena fatua*. Weeds affect growth, yield and quality of crop plants adversely and reduce soil fertility, compete with the crop plants for soil moisture, nutrients, space and sunlight.

Day by day, weed control through herbicides is increasing and popularizing among farmers. Because, weed control through manual method is time consuming and tedious and become very costly due to unavailability of labour in peak period and labour charges are also high due to shifting of agricultural labours to industries for better and assured wages. The effectiveness of herbicides largely depends upon the habitat, weed composition and density of weeds with pre-sowing or pre-emergence application of herbicides.

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The weeds can be controlled right from the germination stage resulting into a weed free environment from early stage of crop, but subsequent flushes of weeds that appear at later stage of crop growth cannot be controlled effectively, under this situation, the integrated weed control method using herbicides in conjunction with manual weeding or inter cultivation would provide more effective weed control.

## Materials and Methods

### Experimental site

The field experiment was conducted at Instructional Farm, Department of Agriculture, Swami Vivekanand University Sagar, Madhya Pradesh during *Rabi* season 2017. The soil of the experimental field was clayey in texture and slightly alkaline in reaction. The soil was low in available nitrogen, while medium in available phosphorus and potash. Chickpea variety JG-12 was sown @80 kg seed ha<sup>-1</sup> at spacing of 30 cm between the lines, on 01 November, 2017 and harvested on 07 March, 2018. The experiment was laid out in randomized block design with nine weed control treatments, viz. Pendimethalin @ 0.75 kg a.i. ha<sup>-1</sup> (Pre-emergence), Oxyfluorfen @ 0.100 kg a.i. ha<sup>-1</sup> (Pre-emergence), Metribuzin @ 0.75 kg a.i. ha<sup>-1</sup> (Pre-emergence), Imazethapyr @ 0.75 kg a.i. ha<sup>-1</sup> (Post-emergence), Propaquizafop @ 0.75 kg a.i. ha<sup>-1</sup> (Post-emergence), Quizalofop-ethyl @ 0.40 kg a.i. ha<sup>-1</sup> (Post-emergence), Hand weeding 30 & 45 DAS, Weed free and Control and experiment was carried out with three replications. Recommended package of practices except weed control treatments were followed for raising the crop. A uniform dose of fertilizers 20-50-20, N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O kg ha<sup>-1</sup> was applied at the time of sowing in furrows. Pre-emergence and Post-emergence herbicides were applied one day before and after sowing, respectively using a knapsack sprayer fitted with flat fan nozzle with a spray volume of 600 litres of water per hectare. Hand weeding was done with the help of Khurpi

when required in weed free treatment. Number of branch per plant, Plant height (cm) and Dry weight plant<sup>-1</sup> was recorded at 20th, 40th, 60th, day stages of crop growth. After harvesting yield of crop calculated by per plot basis and then it converted into t ha<sup>-1</sup> after that economics of different treatments was calculated.

### Treatment details

The details of treatments are given as under

**T<sub>1</sub>**: Pendimethalin @ 0.75 kg a.i. ha<sup>-1</sup> (Pre-emergence)

**T<sub>2</sub>**: Oxyfluorfen @ 0.100 kg a.i. ha<sup>-1</sup> (Pre-emergence)

**T<sub>3</sub>**: Metribuzin @ 0.75 kg a.i. ha<sup>-1</sup> (Pre-emergence)

**T<sub>4</sub>**: Imazethapyr @ 0.75 kg a.i. ha<sup>-1</sup> (Post-emergence)

**T<sub>5</sub>**: Propaquizafop @ 0.75 kg a.i. ha<sup>-1</sup> (Post-emergence)

**T<sub>6</sub>**: Quizalofop-ethyl @ 0.40 kg a.i. ha<sup>-1</sup> (Post-emergence)

**T<sub>7</sub>**: Hand weeding 30 & 45 DAS

**T<sub>8</sub>**: Weed free

**T<sub>9</sub>**: Control

## Results and Discussion

### Growth Parameters

An examination of data (Table 1) revealed that different weed management treatments exerted their significant effect on plant height, branches plant<sup>-1</sup> and dry weight plant<sup>-1</sup> at 60 DAS. Significantly higher growth parameters viz., plant height, branches plant<sup>-1</sup> and dry weight plant<sup>-1</sup> was observed under weed free (T<sub>8</sub>) and lowest recorded under control (14.79 cm). Among the herbicidal treatments highest plant height (18.92), branches plant<sup>-1</sup> (7.17) and dry weight plant<sup>-1</sup> (479.39) recorded under the application of oxyfluorfen @ 0.240 kg ha<sup>-1</sup> PE (T<sub>2</sub>) Which is statistically at par with application of pendimethalin 30% EC @ 0.900 kg ha<sup>-1</sup> PE (T<sub>1</sub>) plant height (18.23), branches plant<sup>-1</sup> (6.97) and dry weight plant<sup>-1</sup> (469.27) respectively, followed by metribuzin @ 75 g ha<sup>-1</sup> PE (T<sub>3</sub>).

**Table 1:** Effect of different treatments on plant height, branches and dry weight plant<sup>-1</sup> at 60 DAS

Treatments	Plant height	Branches Plant <sup>-1</sup>	Dry weight plant <sup>-1</sup>
T <sub>1</sub> - Pendimethalin 30% EC @ 0.900 kg ha <sup>-1</sup> PE	18.23	6.97	469.27
T <sub>2</sub> - Oxyfluorfen @ 0.240 kg ha <sup>-1</sup> PE	18.92	7.17	479.39
T <sub>3</sub> - Metribuzin @ 75 g ha <sup>-1</sup> PE	17.85	6.78	448.43
T <sub>4</sub> - Imazethapyr @ 75 g ha <sup>-1</sup> POE at 20 DAS	17.18	6.49	435.76
T <sub>5</sub> - Propaquizafop @ 75 g ha <sup>-1</sup> POE at 20 DAS	16.63	6.27	424.99
T <sub>6</sub> - Quizalofop-ethyl @ 40 g ha <sup>-1</sup> POE at 20 DAS	15.29	6.12	413.45
T <sub>7</sub> - HW & IC at 35-45 DAS	17.95	6.90	459.51
T <sub>8</sub> - Weed free	19.21	7.26	490.22
T <sub>9</sub> - Control	14.79	5.10	254.30
S.Em. +	0.47	0.36	35.55
C.D. (P=0.05)	1.37	1.04	45.93

### Yield Attributes

Data on yield attributes viz., mean number of pods plant<sup>-1</sup>, mean pod weight plant<sup>-1</sup>, grain weight plant<sup>-1</sup> and Test weight (g) as influenced by various treatments are shown in the Table 2. Mean values of number of pods plant<sup>-1</sup>, pod weight plant<sup>-1</sup> and Test weight (g) were observed that yield attributes significantly influenced due to various herbicidal treatments.

### Number of pods plant<sup>-1</sup>

Significantly higher yield attributes viz., pods plant<sup>-1</sup> (28.50), mean pod weight plant<sup>-1</sup> (2.23) and Test weight (g) was

observed under weed free (T<sub>8</sub>) and lower number of pods plant<sup>-1</sup> (23.71) was observed under unweeded control (T<sub>9</sub>) under the investigation.

Among the herbicidal treatments highest number pods plant<sup>-1</sup> (27.70) was observed under weed free (T<sub>8</sub>) and lower number of pods plant<sup>-1</sup> (23.71) recorded under the application of oxyfluorfen @ 0.240 kg ha<sup>-1</sup> PE (T<sub>2</sub>) Which is statistically at par with application of pendimethalin 30% EC @ 0.900 kg ha<sup>-1</sup> PE (T<sub>1</sub>) pods plant<sup>-1</sup> (28.50) was observed under weed free (T<sub>8</sub>) and lower number of pods plant<sup>-1</sup> (23.71), followed by metribuzin @ 75 g ha<sup>-1</sup> PE (T<sub>3</sub>).

**Table 2:** Effect of different treatments on number of pods plant<sup>-1</sup>, Number of seeds pod<sup>-1</sup> and Test weight (g) harvest

Treatments	Pods plant <sup>-1</sup>	Number of seeds pod <sup>-1</sup>	Test weight (g)
T <sub>1</sub> - Pendimethalin 30% EC @ 0.900 kg ha <sup>-1</sup> PE	27.51	2.17	26.30
T <sub>2</sub> - Oxyfluorfen @ 0.240 kg ha <sup>-1</sup> PE	27.70	2.19	26.53
T <sub>3</sub> - Metribuzin @ 75 g ha <sup>-1</sup> PE	25.97	2.11	25.87
T <sub>4</sub> - Imazethapyr @ 75 g ha <sup>-1</sup> POE at 20 DAS	25.51	2.05	25.54
T <sub>5</sub> - Propaquizafop @ 75 g ha <sup>-1</sup> POE at 20 DAS	24.83	2.00	25.17
T <sub>6</sub> - Quizalofop-ethyl @ 40 g ha <sup>-1</sup> POE at 20 DAS	25.30	1.91	24.75
T <sub>7</sub> - HW & IC at 35-45 DAS	27.03	2.14	26.23
T <sub>8</sub> - Weed free	28.50	2.23	26.76
T <sub>9</sub> - Control	23.71	1.37	22.93
S.Em. +	0.83	0.06	0.39
C.D. (P=0.05)	2.40	0.17	1.12

### Number of seeds per pod

Which remain statistically at par with pendimethalin 30% EC @ 0.900 kg ha<sup>-1</sup> PE(T<sub>1</sub>), oxyfluorfen @ 0.240 kg ha<sup>-1</sup> PE(T<sub>2</sub>), metribuzin @ 75 g ha<sup>-1</sup> PE(T<sub>3</sub>), imazethapyr @ 75 g ha<sup>-1</sup> POE at 20 DAS(T<sub>4</sub>) and HW & IC at 35-45 DAS(T<sub>7</sub>) in 2017, all treated parameters are statistically at par except Quizalofop-ethyl @ 40 g ha<sup>-1</sup> POE at 20 DAS (T<sub>6</sub>). On the mean basis result various data recorded which remain statistically at par with pendimethalin 30% EC @ 0.900 kg ha<sup>-1</sup> PE (T<sub>1</sub>), oxyfluorfen @ 0.240 kg ha<sup>-1</sup> PE (T<sub>2</sub>), metribuzin @ 75 g ha<sup>-1</sup> PE (T<sub>3</sub>) and HW & IC at 35-45 DAS (T<sub>7</sub>). In contrast, significantly the lowest number of seeds per pod (1.37) was observed under unweeded control (T<sub>9</sub>) in 2017 on the mean basis.

### Test weight (g)

The weed free (T<sub>8</sub>) recorded significantly higher test weight (26.76 g) in 2017 on the mean basis, which remain

statistically at par with all treatment except quizalofop-ethyl @ 40 g ha<sup>-1</sup> POE at 20 DAS (T<sub>6</sub>) in 2017 on the mean basis, which remain statistically at par with pendimethalin 30% EC @ 0.900 kg ha<sup>-1</sup> PE(T<sub>1</sub>), oxyfluorfen @ 0.240 kg ha<sup>-1</sup> PE (T<sub>2</sub>), metribuzin @ 75 g ha<sup>-1</sup> PE(T<sub>3</sub>) and HW & IC at 35-45 DAS (T<sub>7</sub>). On the other hand, the unweeded control (T<sub>9</sub>) registered significantly the lowest test weight (22.93g) in 2017 on the mean basis.

### Yield studies

The data on grain yield (kg ha<sup>-1</sup>), straw yield (kg ha<sup>-1</sup>), biological yield (kg ha<sup>-1</sup>) and harvest index (%) as influenced by various treatments are presented in Table 3.

### Seed yield (kg ha<sup>-1</sup>)

Results summarized revealed that seed yield was significantly influenced due to different weed management treatments during 2017.

**Table 3:** Effect of different treatments on Biological yield (Kg ha<sup>-1</sup>), seed yield (Kg ha<sup>-1</sup>), Straw yield (Kg ha<sup>-1</sup>) and Harvest index (%) at harvest

Treatments	Biological yield	Seed yield	Straw yield	Harvest index
T <sub>1</sub> - Pendimethalin 30% EC @ 0.900 kg ha <sup>-1</sup> PE	5815.73	2696.00	3103.06	46.33
T <sub>2</sub> - Oxyfluorfen @ 0.240 kg ha <sup>-1</sup> PE	5937.20	2793.60	3126.93	45.84
T <sub>3</sub> - Metribuzin @ 75 g ha <sup>-1</sup> PE	5315.53	2491.10	2824.43	46.50
T <sub>4</sub> - Imazethapyr @ 75 g ha <sup>-1</sup> POE at 20 DAS	5176.07	2421.37	2754.70	46.13
T <sub>5</sub> - Propaquizafop @ 75 g ha <sup>-1</sup> POE at 20 DAS	4819.95	2234.97	2584.98	46.47
T <sub>6</sub> - Quizalofop-ethyl @ 40 g ha <sup>-1</sup> POE at 20 DAS	4648.22	2157.47	2490.75	46.51
T <sub>7</sub> - HW & IC at 35-45 DAS	5503.47	2585.00	2918.47	47.00
T <sub>8</sub> - Weed free	6043.53	2872.27	3205.60	47.66
T <sub>9</sub> - Control	2937.66	1277.15	1660.49	43.41
S.Em. +	215.95	223.83	126.86	1.98
C.D. (P=0.05)	622.39	645.13	365.64	NS

The weed free (T<sub>8</sub>) recorded significantly higher seed yield (2872.27 kg ha<sup>-1</sup>) in 2017 which remain at par with all treatment except quizalofop-ethyl @ 40 g ha<sup>-1</sup> POE at 20 DAS (T<sub>6</sub>). On the other hand, significantly the lowest seed yield (1277.15 kg ha<sup>-1</sup>) was observed under unweeded control (T<sub>9</sub>).

### Straw yield (kg ha<sup>-1</sup>)

The weed free (T<sub>8</sub>) recorded significantly higher straw yield (3205.60 kg/ha) in 2017 which remain statistically at par with all treatments expect propaquizafop @ 75 g ha<sup>-1</sup> POE at 20 DAS(T<sub>5</sub>) and quizalofop-ethyl @ 40 g ha<sup>-1</sup> POE at 20 DAS (T<sub>6</sub>). On the other hand, significantly the lowest straw yield (1660.49 kg/ha) was observed under unweeded control (T<sub>9</sub>).

### Biological yield ha<sup>-1</sup>

The weed free (T<sub>8</sub>) recorded significantly higher biological yield(6043.53kg/ha) in 2017 on the mean basis results, which remain statistically at par with imazethapyr @ 75 g ha<sup>-1</sup> POE at 20 DAS (T<sub>4</sub>), propaquizafop @ 75 g ha<sup>-1</sup> POE at 20

DAS(T<sub>5</sub>) and quizalofop-ethyl @ 40 g ha<sup>-1</sup> POE at 20 DAS(T<sub>6</sub>). On the other hand, significantly the lowest biological yield (2937.66 kg/ha) was observed under unweeded control (T<sub>9</sub>) in 2017 on the mean basis results.

### Harvest index (%)

Data concerning the effect of different weed management treatments on harvest index (%) are presented in Table 3.

The weed free (T<sub>8</sub>) recorded significantly higher harvest index (47.66%) in 2017 on the mean basis. Among the herbicidal treatments Quizalofop-ethyl @ 40 g ha<sup>-1</sup> POE at 20 DAS T<sub>6</sub> (46.51%) which remain statistically at par with Propaquizafop @ 75 g ha<sup>-1</sup> POE at 20 DAS T<sub>5</sub> (46.47%), and lowest harvest index (43.41%) was observed under unweeded control (T<sub>9</sub>).

### Economic studies

Data in respect to gross monetary returns, net monetary returns and B:C ratio after harvest of the crop as influenced by various treatments are presented in Table 4.

### Cost of cultivation

An examination of data (Table 4) revealed that higher cost of cultivation with weed free ( $T_8$ ) incurred higher (Rs. 26,765  $ha^{-1}$ ) in 2017 on the mean basis. The lowest cost of cultivation (Rs. 21,197  $ha^{-1}$ ) was recorded with unweeded control ( $T_9$ ).

### Gross return

The data on economics (Table 4) showed that all the weed management treatments accrued remarkably higher gross returns over unweeded control ( $T_8$ ) which recorded minimum gross return (Rs. 117667  $ha^{-1}$ ) during 2017 on the mean basis. The minimum gross return (Rs. 53454  $ha^{-1}$ ) were accrued under unweeded control ( $T_9$ ).

**Net returns:** A perusal of data (Table 4) revealed that all weed management treatments accrued higher net returns over unweeded control ( $T_9$ ) which realized the loss of (Rs. 32237  $ha^{-1}$ ) in the years on the mean basis. Maximum net returns (Rs. 90902  $ha^{-1}$ ) were accrued under treatment weed free ( $T_8$ ).

### B:C ratio

The data obtained in accordance to gross return and cost of cultivation (Table 4), highest B:C ratio of 4.53 was obtained with oxyfluorfen @ 0.240  $kg\ ha^{-1}\ PE$  ( $T_2$ ) followed by weed free ( $T_8$ ), pendimethalin 30% EC @ 0.900  $kg\ ha^{-1}\ PE$  ( $T_1$ ) and HW & IC at 35-45 DAS ( $T_7$ ). However, the lowest B:C ratio of 2.51 was obtained with unweeded control ( $T_9$ ).

**Table 4:** Effect of different treatments on Cost of cultivation (Rs.  $ha^{-1}$ ), Gross returns (Rs.  $ha^{-1}$ ), Net return (Rs.  $ha^{-1}$ ) and B:C ratio

Treatments	Cost of cultivation (Rs. $ha^{-1}$ )	Gross returns (Rs. $ha^{-1}$ )	Net return (Rs. $ha^{-1}$ )	B:C ratio
$T_1$ - Pendimethalin 30% EC @ 0.900 $kg\ ha^{-1}\ PE$	25437	110941	85504	4.35
$T_2$ - Oxyfluorfen @ 0.240 $kg\ ha^{-1}\ PE$	25289	114742	89453	4.53
$T_3$ - Metribuzin @ 75 $g\ ha^{-1}\ PE$	25800	102312	76513	3.96
$T_4$ - Imazethapyr @ 75 $g\ ha^{-1}\ POE$ at 20 DAS	24978	99476	74498	3.98
$T_5$ - Propanil @ 75 $g\ ha^{-1}\ POE$ at 20 DAS	24380	91965	67585	3.77
$T_6$ - Quizalofop-ethyl @ 40 $g\ ha^{-1}\ POE$ at 20 DAS	25254	88682	63428	3.51
$T_7$ - HW & IC at 35-45 DAS	24656	106144	81488	4.30
$T_8$ - Weed free	26765	117667	90902	4.39
$T_9$ - Control	21197	53434	32237	2.51

### Conclusion

On the basis of the results obtained in this study, it is concluded that the application of RDF + Liquid fertilizers (premix) @ 1.0 litre  $ha^{-1}$  treatment gave maximum plant height, highest number of branches per plant, dry weight per plant, maximum dry weight of pod, maximum number of grain per pod, maximum number of pod per plant, maximum seed yield and maximum harvest index, net monetary returns and B:C ratio.

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